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22nd December 1898

BEET-ROOT DISTILLATION:

CONTAINING

A Report on the Subject

BY

DR. AUGUSTUS VOELCKER, F.R.S.,
Consulting Chemist to the Royal Agricultural Society of England.

AND

PARTICULARS AND PRICES OF

BEET-ROOT DISTILLERIES

AS FITTED BY

MESSRS. D. SAVALLE & CO.,

OF

64, AVENUE DE L'IMPÉRATRICE, PARIS,
AND
10, BASINGHALL STREET, LONDON, E.C.

Price One Shilling.
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This Pamphlet is divided as under:—

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We do not want to insist on Dr. Voelcker's Report, his name is sufficiently known amongst farmers and agriculturists; they know the great value of all his writings. Mr. James Howard's opinion on the Savalle Stills, and that of Mr. W. Crookes, we are also proud to print in this pamphlet, as that of two scientific and practical men, who have studied the subject of Beet-root in the most serious manner. The extract from the Food Journal is of great value, owing to the staff of writers who are some of the first scientific men of Great Britain.

IMPORTANT NOTICE.

We beg to inform persons who may be visiting the Berkshire Distillery Company, that when Mr. Robert Campbell decided to erect that beet-root distillery on his estate at Buscot Park, he applied to Messrs. D. Savalle & Co. for their Distilling and Rectifying Stills, and also for the general plan of a beet-root distillery in accordance with the Excise laws and regulations. Messrs. Savalle succeeded in surmounting all obstacles and adapting beet-root distillation to the requirements of the English Excise laws.

Mr. Robert Campbell adopted the presses of Mr. A. Collette, but he has since preferred the method of fermenting the beet, after crushing them in slices.

The Savalle Stills gave Mr. R. Campbell such satisfaction that he has this year ordered two more very large ones, which will probably be at work in the course of this month (December, 1870), thus trebling the production of the Buscot Distillery.

There are various methods of operating in beet-root distillation:

1. To slice the beet-roots, press them to extract the juice, which is sent into vats to be fermented, after which the distillation takes place. By the presses the pulp or food for cattle is in a very good state. The press is the process most in use on the Continent.

2. To slice the beet-roots, macerate them, run the juice into fermenting vats, and distill it after fermentation. In some circumstances this process is found more advantageous than the presses; but the pulp is of an inferior quality to that obtained by the presses.

3. To slice the beet-roots, and put them immediately into the fermenting vats and to distill. This process is very little used, and the pulp is really of very inferior quality and very bulky.

Either of these processes being adopted, the use of the powerful Savalle Stills is indispensable to obtain pure and clean spirit out of beet-root at the high strength of 69 or 70 per cent.

On pages 60, 62, 64, we give estimate costs of the plant of beet-root distilleries with the presses; but the plant of such distilleries without the presses, by the maceration or fermenting the slices, would cost less. In all cases, to have a fair idea of the cost of a beet-root distillery, it is advisable to write to Messrs. Savalle's agents, 10, Basinghall Street, London, E.C., specifying the quantity of beet-roots required to be distilled in the season (20 weeks), and estimate costs of beet-root distilleries to accomplish the work mentioned, by the three different methods, will be sent.

INTRODUCTION.

We publish this pamphlet specially with reference to Beet-root Distillation, but it must be well understood that Messrs. D. Savalle and Co., erect all kinds of distilleries on the best principles; their own patent systems.

Beet-root Distillation is very profitable to agriculture, because it gives the cheapest and best food for fattening cattle, sheep and pigs, consequently, cheap manure which is so essential to farmers; Beet-root Distillation is the best means of keeping the land in good condition.

Many barren countries have become fertile and rich by agricultural distilleries, Beet-root Distillation producing the highest revenue from the land.

When winter comes and work is scarce on the farm, the distillery gives work to the country labourers.

It was for the purpose of introducing Beet-root Distillation, by means of the excellent Savalle Stills, that we came to England some years ago. But English agriculturists were not ripe for Beet-root Distillation, also they had in mind the failures of some years ago, failures due to the bad Stills employed. On the Continent there are more than 16,000 Agricultural Distilleries; in England there is only one, that of Mr. Robert Campbell, of Buscot, erected by Messrs. D. Savalle and Co.

Beet-root Distilleries, to be profitable, must produce good food and spirit of first quality, it is what the Savalle Stills produce at Mr. Robert Campbell's Distillery, where the cattle, sheep, pigs and horses are very fond of the pulp (the residue after distillation) and thrive well on it; also the superior spirit manufactured there is readily employed for all purposes for which perfectly pure spirit is desirable, by Compounders, Liqueur Makers, Perfumers, Chemists, &c.

There are no instances, on the Continent, of farmers having lost money by Beet-root Distillation; on the contrary, they have made, and are making large fortunes with it.

Whoever has patience to read this pamphlet to the end, will see how profitable Beet-root Distillation is, and what capital it requires to be successful.

To show the importance of Messrs. Savalle and Co's. firm, we beg to append a list of Distilleries they have erected during the last few years, it may be instructive to persons interested in this subject to know where and by whom the Savalle Stills have been adopted.

JAMES BARRAL & CO.,
10, Basinghall St., London, E.C.
Sole Representatives in Great Britain of
MESSRS. D. SAVALLE & CO., 64, Avenue de l'Impératrice, Paris.

EXTRACTS

FROM

REPORTS ON THE SAVALLE STILLS.

"The Distilling and Rectifying Savalle Stills, which, on the occasion of my visit to Mr. Robert Campbell's beet-root distillery in Berkshire, I saw in operation, produce an extremely pure alcohol of very high strength, which cannot be distinguished from pure spirit of wine.

"Dr. A. Voelcker, F.R.S."

"Distilling and refining the crude beet-root by the Savalle Stills, may be carried out by any man of moderate means and ordinary intelligence, for in great measure the Savalle Stills may be said to be self-regulating.

"Dr. A. Voelcker, F.R.S."

"A still without the Savalle steam regulator is like a vessel without a compass, exposed to all chances of error and accidents.

"J. Pezeyre."

"The raw sugar in molasses represents the alcohol in low wines; sugar must be refined in order to become white and of a sweet and pure taste. Low wines have to undergo a similar refining process, known under the name of rectification. Well refined beet-root sugar is identical with equally well refined cane sugar, and perfectly rectified beet-root spirit is identical with pure spirit of wine.

"J. Pezeyre."

"By means of the Savalle Stills alcohol is obtained from beet-root of great purity and of quality superior to ordinary spirit of wine.

"J. Pezeyre."

"Beet-root distillation will succeed in England because the Savalle Stills are undoubtedly better than those hitherto introduced in England.

"James Howard, M.P."

"The Savalle system for beet-root distillation appears to be of later date and even more complete than the other systems, and it has been satisfactorily tested by the success Mr. R. Campbell has obtained with it. These stills produce spirit of perfect purity, and are arranged in accordance with the excise regulations.

"W. Crookes, F.R.S."

"Messrs. Savalle & Co. undoubtedly have a speciality for excellence and economy in the construction of this class of engineering works, (beet-root distilleries.) The distillation of beet-root will in due course play an important part in the economical resources of the country.

"*Food Journal*, Aug. 1, 1870."

"The Savalle Stills are marvellous, and all the Spanish distillers admire the results they obtain with them.

"Joaquin de la Gandara,
"Chairman of the Saragossa Railway Co."

"We have great satisfaction in announcing the success of a special Rectifying Still, which has been working since the end of June last. Taking all circumstances into consideration, we agreed to order one from the celebrated establishment of D. Savalle and Co., and we can commend to you with great satisfaction, that our expectations are satisfied in every respect, not only that we are now able to produce one of the finest qualities of spirits, which has gained the approbation of the analists, but it quite meets our approbation in producing the spirit it has."—*Extract from a Report made at the General Meeting of the Shareholders of the Society Actien-Fabrikshof at Temeswar (Hungary.)*

"In point of economy and superiority of the products of distillation, Savalle Stills leave nothing to be desired. The principle upon which this apparatus is constructed, rests on the difference in the specific heat of alcohol and the compounds with which it is associated in low wines, and the continuous separation and elimination of the various products of distillation."

DR. VOELCKER *and* J. PEZEYRE.

"Where beet sugar-making is profitable, beet-root spirit-making is even more profitable; and on soils and in climates where the quantity of saccharine matter yielded by the roots is too small to be worth extracting, distillation of alcohol may nevertheless be amoney-making business, and in proof of this assertion, the fact is pointed out that large numbers of beet-root sugar works in Prussia, Austria and France have been lately converted into distilleries. We are quite aware that spirit-making from beet-root has been tried in this country and has failed; but so has sugar-making; and the very authorities who formerly satisfied themselves that the business could not pay, are now warmly congratulating the British public upon the advent of this new help to the farmer, and hope to the under-paid agricultural labourer.

This is because inventors will keep on improving upon processes and apparatus; and for just the same reason the failure of beet-root distillation years ago ceases to tell against the profitableness of that branch of industry at the present moment. The extension of beet distilleries on the Continent has been brought about by a recently improved method of macerating and distilling the beet-roots, by which is produced a spirit equal in quality to grain spirit, and quoted at a high price in the French markets. The failure of the experiments made in England some years ago mainly arose from the inferior quality of the spirit obtained, and this disadvantage has now been completely overcome. *The principal agent in the improved process is the Savalle Still*, which is introduced into this country by Mr. James Barral, son of the distinguished agricultural chemist."

From the " Chamber of Agriculture Journal," March 29th, 1869.

SOME OF THE MOST IMPORTANT

DISTILLERIES

ERECTED BY

MESSRS. D. SAVALLE & CO.,

ON THE "SAVALLE" PATENT SYSTEM,

FOR THE DISTILLATION OF

BEETROOT, GRAIN, MOLASSES, WINE, RICE, MAIZE,
&c., &c.

GREAT BRITAIN.

Robert Campbell, Esq.	Buscot (Berkshire)	5
Bernard and Co.	Leith Distillery	1
Hills and Underwood	Norwich	1

ALGERIA.

Khan	Chamora	2
Fournier and Co.	Philippeville	2

AMERICA.

Felix Denegri	Hacienda de Chacavento	1
L. Engel	Caracas (Venezuela)	1
Munzer and Spann	Rio Janiero (Brazil)	1
Juan Ollivella	„ „	1

AUSTRIA.

Actien Fabrikshof Society	Temesvar	1
Camille de Laminet	Gattendorf (Silesia)	2
Latzel	Bartzdorff „	3

J. Latzel and Co.	Pawlowitz (Moravia)	2
A. Schœller and Carl Leidenfrost	Leva (Hungary)	2
A. Schœller and Carl, Leidenfort	Gênoa	2
K. Kammel and Co.	Grusbach (Moravia)	2
P. Primavesi	Olmutz	1
Pokorny, Brothers, and Hugo Jelinek	Pilsen (Bohemia)	1
H. R. H. Prince of Salm	Raitz (Moravia)	3
Adolf Poper	Pilsen (Bohemia)	2
Schultz and Pollak	Falkas Dovorany (Hungary)	2
E. Siegl	Szolcsan ,,	2

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Badische Aniline & Soda Fabrik Society	Ludwighafen	1

BELGIUM.

A. Dumont	Chassart	2
Carbonelle-Nerinckx	Tournai	2
J. and O. Clayes-Fievet.	Ghent	1
Meeus	Antwerp	1
Bal and Co.	,,	1
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Haase	Veendyk	1
Raimbeaux and Legrand	Tongres N. Dame.	2
J. Sklin	Liege	1
Ven-den-Bergh and Co.	Antwerp	1
The Hon. Baron de St. Symphorien	Mons	2

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Hoper	Hamburg	1

Nathan and Co.	Hamburg	3
A. Retemeyer	Bremen	4

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Abel-Bresson	Dijon, Côte d'Or	1
Bayard de la Vingtrie and Co.	Chauny, Aisne	6
Belin	Brie-Comte-Robert, Seine et Marne	3
Bernard, Brothers, and Leurant	Bordeaux, Gironde	1
Bigo-Tilloy and Son	Lille, Nord	5
M. and A. Billet	Cantin, Nord	3
A. Billet and Co	Sermaize, Marne	2
A. and F. Billet	Marly, Nord	2
Birault	L'Isle, Deux Sèvres	1
Boulet	Rouen, Seine Inférieure	3
Borgolt and Thomin	Couvrelles, Aisne	1
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Braconnier	Chavagné, Deux Sèvres	1
Caille	Chaintereaux, Seine et Marne	1
Christmann, Shulinger & Schultz	Colmar, Haut-Rhin	1
Chatriot-Wallet	Tremonvillers, Oise	2
L. Crespel and Co.	Quesnoy-sur-Deule, Nord	2
L. Cugniez and Co.	Bucy-le-Long, Aisne	2
A. Decauville	Petit-Bourg, Seine et Oise.	1
Delavigne	Rouen	1
Deschanvres and Co.	Denain, Nord	2
Delloye Lelièvre	Iwuy ,,	1
C. Droulers	Wasquehal, Nord.	2
Charles Droulers	Roubaix ,,	3
Louis Droulers	Ascq ,,	2
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Durand	Ivry-le-Temple, Oise	2
Durin	Steene, near Bergues, Nord	2

A. Durel and Co.	Denain, Nord	2
F. Dehaynin	Aux Corbins, near Lagny, Seine et Marne	2
Duriez and Droulers	Coppenansfort, Nord	1
Fournier, Leveaux, Bailly and L. Petit	Choconin, near Meaux, Seine et Marne	1
Fretin et Ghestem	Deulemont, Nord	1
The French and Belgian Company	Marseilles	2
Gouvion Deroy	Denain, Nord	2
Gentil	Alfort, Seine	1
Goblet, Son and Co.	Angoulême, Charente	1
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Journeil	Melun, Seine et Marne	1
Lamarque	Suilles, Gers	1
A. Lefebvre	Corbehem, near Douai, Nord	3
Lamblin, Brothers	Marquettes, near Lille	1
Leduc	Frocourt, Oise	1
C. Legrand	Castle of Sassy, near Jort Calvados	3
C. Legrand	Paris	3
Le Cocq	Mans, Sarthe	2
Lesaffre and Bonduelle	Marquette-les-Lille, Nord	4
P. Lejeune and Co.	Argenteuil, Seine et Oise	2
Lejeune	La Brosse, Indre	2
Lignieres	Villeneuve - les-Chanoines, Aude	2
G. Marchandise	Fregicourt, Oise	2
Marin-Darbel	Arton, Indre	2
A. Mather and Co.	Toulouse, Haute Garonne	2
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Morlandet	Saint Leger, Loire	2

J. Michaux	Bonnières, Seine et Oise	3
Mignot and Co.	Saint-Mande, Seine	1
Millot-Polloy	Clary, Nord	2
Mastron	Creteil, Seine	1
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A. Pouillet	Niort, Deux Sèvres	1
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Lemaitre	Baquepuis, Eure	2
Perdrizet	Soissons, Aisne	2
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V. Delgute and Co.	St. Pierre les Calais, Nord	2
V. Denis and Co.	Saint Denis, Seine	1
Violet	Aubigny, Seine et Marne	1
E. Vouters	Halluin, Nord	1
H. Wagner and Co.	Lewarde, Nord	2
A. Pennelier	Laneuville-Roy, Nord	2
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A. Collette	Seclin, Nord	1
Gomaux and Co.	Tournes, Ardennes	1
Coeffier	Mantes	1
D. Coisne and Co.	Merville, Nord	1
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J. Braconnier	Chavagné, Deux Sèvres	1
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A. Andre	Brissay-Joigny, Aisne	2
Brangier	Estres near la Creche	1

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Friedeberg	Magdebourg	2
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Henzel and Freise	,,	2
Galle	Stettin	3
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Mampe	Stargard	2
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Manuel Pareja . .	,, ,,	. 2
Pedro de Domecq .	,, ,,	. 2
Sevil, Hermanos and Pohndorf . .	,, ,,	. 2
Peninsular Sugar Society.	Madrid . .	. 2
Coralez Peralta . .	,, . .	. 1
R. La Chica Rodriguez y Aurioles . .	Grenada . .	. 2
J. Agrela . .	,, . .	. 2
Cecilio de Roda .	Albumol . .	. 1
Larios and Son .	Malaga . .	. 2
Joaquin de la Gandara, (Chairman of the Saragossa Railway Comp^y^.	Albacete . .	. 1

RUSSIA.

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A. Wolfsmidt . .	Riga . .	. 1

SWEDEN.

J. Tranchell and Co. .	Landskrona .	. 1

WALLACHIA.

Demetre-Morait . .	Bucharest .	. 1
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REPORT

ON

THE CULTURE OF BEET-ROOT IN GREAT BRITAIN AND THE DISTILLATION OF BEET-ROOT SPIRIT.

By DR. AUGUSTUS VOELCKER, F.R.S.,
Consulting Chemist to the Royal Agricultural Society of England.

The cultivation of Beet-root has been carried out in France, Germany and Belgium for more than a quarter of a century with manifest advantage to the Continental farmers and manufacturers of sugar and alcohol.

More recently beet culture has found its way into England, and even into Russia. Both in France and Germany the growth of Beet-root is extending from year to year, and there appears every prospect that the successful attempts which have been made recently to introduce the Silesian sugar-beet as a farm crop into England will lead to a large extension of its growth both in England and in Ireland.

The sugar-beet, like the common mangold-wurzel is derived from the *beta cicla* and *beta vulgaris*, biennial plants which grow well near the sea shores of south-western Europe.

A great many varieties of sugar-beets have been obtained by crossing and culture, and much attention has been given by Continental farmers to the selection of roots rich in sugar. Most of these varieties have no decidedly permanent characters, and for this reason we need not enter into a detailed description of the many kinds of sugar-beets which have been brought under the notice of the agricultural public. Suffice it to mention that all the different varieties may be regarded as belonging to one of the following five chief sorts:—

1. The French or Belgian Sugar-beet.
2. The Quedlinburg (German) Sugar-beet.
3. The Silesian Beet.
4. The Siberian Beet.
5. The Imperial Beet.

Of these five principal sorts, the Silesian beet is more largely grown, and by many held in higher estimation than any other kind. There are two varieties of Silesian sugar-beets, the red, or rather rose-coloured, and the white. Except in the colour of the root and tops there is little difference between the red and the white Silesian beet, both in regard to shape and quality.

Silesian Beet.—The Silesian beet is a pear-shaped root, white in the body, and light green on the top, which grows above ground, and is very broad. Flesh greenish-white, stronger in the tops than the preceding varieties. The leaves are green with very light green coloured ribs, and strong green and long petioles.

The Silesian beet does not yield so large a per centage of sugar as the two preceding sorts, nevertheless it is much more extensively grown, both in France and Germany, than any other variety, because it yields a larger weight of roots per acre, is of a vigorous growth, and produces a larger amount of sugar per acre.

Selection of Seed.—It is a matter of much practical importance to sow seed from well shaped roots carefully selected from a large number of roots on account of their symmetrical form, high density and richness in sugar. Experience has shown that beet-roots rich in sugar produce seeds from which roots, also rich in sugar, may be raised, whilst all seed from roots poor in sugar, as a rule, produce inferior roots.

It is therefore of much importance to the beet-root grower to start with good seed. Great attention is paid on the Continent, especially in the north of Germany, to the growing of true and superior beet-root seed. Perhaps nowhere are grown beets richer in sugar than in the neighbourhood of Magdeburg, in Prussia; and for this reason we would strongly advise English agriculturists intending to cultivate sugar-beets to procure their seed from that locality. As regards the shape and weight of roots most desirable to be grown, it may be stated that good sugar beets possess the following characters:

1. They have a regular pear-shaped form and smooth skin; carrot-like, long tapering roots are considered inferior to pear-shaped Silesian beets.

2. They do not throw out many fibrous-branched roots or forks.

Forked roots are difficult to clean, and not so readily pulped as well-grown, symmetrical, pear-shaped roots.

3. They have a white, firm and dense flesh, and clean sugary taste. Such roots are readily reduced to a fine

pulp by proper machinery. Soft and spongy, thick-skinned roots are always more watery than beets of a uniformly firm, hard and close texture.

4. Good sugar-beets generally weigh from 1¼ lb. to 2 lbs. Very small or very large roots are not usually well suited for the manufacture of sugar or spirit. Roots weighing under ¾ lb. are generally woody, and besides sugar contain too large a proportion of other constituents, which prevent, in a large measure, the extraction of crystallized sugar from the juice; whilst roots weighing more than 2½ lbs. are generally too watery and too poor in sugar; still such beets can be employed for distillation.

5. Good sugar-beets always have small tops, and no tendency to become necky.

6. Such roots do not show much above ground, but grow almost entirely in the ground. Roots, the tops of which grow above ground, do not yield so much sugar as those that bury themselves better in the soil, for the heads of the roots being exposed to light, turn greenish, and yield less crystallizable sugar than the parts covered by the soil. Manufacturers of sugar cut off the greenish-coloured heads of the roots before they are pulped; and hence much waste takes place when beet-roots, grown in a large measure above ground, are sent to the manufactory; in beet-root distilleries the heads of the roots are not cut off.

7. Generally speaking, the higher the specific gravity of a beet-root, the more it is esteemed for its sugar-producing qualities. Good roots are considerably more dense than water, and rapidly sink to the bottom of a vessel filled with water.

8. The expressed juice of good beet-roots has a clean sweet taste, and a specific gravity of from 1·060 to 1·070. When very rich in sugar, the specific gravity of the juice rises above 1·070, reaching occasionally 1 075 to 1·078.

Climate and Soils of Great Britain suitable for the culture of Sugar-beet.—There are many persons in this country who are either altogether unacquainted, or but very imperfectly instructed on matters relating to the growth of sugar-beets, who entertain the view that neither the climate nor the soils of England and Ireland are conducive to the economical growth of that crop. It is believed by them that beet-roots require a large amount of heat to arrive at maturity, and therefore do not do so well, when grown in the more temperate climate of England, as on the Continent, in localities having a much higher summer temperature than most places in Great Britain.

This, however, is a mistake; for the localities most favourable to the cultivation of sugar-beets on the Continent are not the south of France or of Germany, but the northern departments of France, and the plains of Magdeburg, and other localities in the north of Germany, which districts, we need hardly observe, are much more temperate than the southern countries of Europe. In the south of Germany, with few exceptions, the growth of sugar-beet indeed has not made any progress, whilst in the north of Germany and France it is increasing considerably year by year, and the beet-root is considered one of the most important and profitable crops that can be raised on the farm.

Again it may be noted that the climate of the districts in which beet-root culture is carried on with the greatest success resembles closely that of England, and that neither the summer temperature of Holland or Belgium materially differs from that of many parts of England and Ireland.

Character of the soils best adapted, or unsuitable, for the growth of beet-roots.—Like other green crops, the sugar-beet, though not equally well adapted for every kind of soil, is nevertheless grown on land varying greatly as regards depth, texture, and general physical and chemical properties. It may, however, be observed at once, that all soils incapable of being cultivated to a depth of at least 16 inches, are unsuited for the growth of sugar-beet, which, unlike the ordinary yellow globe mangold, grows almost entirely under ground, and therefore cannot be cultivated with advantage on very shallow soils. Peaty soils are not suited for beets, nor stiff clay soils, except they are well cultivated and thoroughly pulverized, when, indeed, they become most useful for the growth of beets. All soils in a bad state of cultivation are unsuitable for their cultivation.

The chief requisites in a soil upon which this crop is intended to be raised, are a sufficient depth and ready penetrability by the plant. A good friable, deep turnip loam, and all soils in which potatoes grow to perfection, are perhaps the most eligible of all for the growth of beet-roots. A moderate, or even large amount of clay, far from being an undesirable element, is very useful for this crop, provided the land is well worked, and the clay has become friable by exposure to the air, and by general good management.

It is sometimes stated that beet-root can only be grown to perfection on light, very porous, and naturally poor soils; but this is a great mistake, for on naturally poor sandy land sugar-beet cannot be grown economically. Such land requires to be previously well dunged in the autumn, and to be liberally treated with superphosphate at the time of sowing, before it will yield a paying crop of beets. On the other hand, there is no soil so well suited for beets as a good, well-worked, deeply cultivated, and thoroughly drained clay loam; or, in other words, a soil containing a good deal of clay, with a fair proportion of sand. Most good clay loams contain sufficient lime to meet the requirements of the beet-root crop. Many light soils, on the other hand, being poor in lime, are much improved by the application of clay-marl, chalk, or quicklime previous to the ploughing up of the land in autumn. On land deficient in lime the sugar-beet is apt to get fingered and toed, and hence care should be taken before taking the land in hand for the cultivation of this crop, to ascertain whether it contains a fair proportion of lime.

The sub-soil has an important influence on this as on all root crops. It should be sufficiently friable to allow the ready penetration of the roots, and be thoroughly well drained; for it is vain to hope to grow successfully good sugar-beets on land resting on a stiff, cold, and partially drained sub-soil. In dealing with rather heavy land, particular attention ought to be paid to autumn cultivation. Deep ploughing in autumn, and stirring the sub-soil without turning it up, and above all steam cultivation, are some of the means of preparing such land for beet-roots.

In short, the same rules which apply to the proper cultivation of the soil for other root crops should guide the farmer in preparing his land for sugar-beets.

Manures for beets.—Experience has shown that the composition of the various kinds of manures which are usually employed in agriculture, has a powerful influence on the quality of the roots. Whilst some produce early maturity, others delay the ripening process, and tend to produce bulk at the expense of quality.

When the object for which the roots are required is to produce sugar, it is of the greatest consequence to exclude from the manuring agents, or their mixture, as much as possible all constituents which interfere with the extraction of sugar in a crystallized state, or which have the effect to favour the production of a heavy crop, poor in sugar, rather than a lighter crop, rich in sugar.

Thus saline manures are very favourable to the luxuriant development of beets, especially when grown on light land. Common salt, for instance, materially increases the yield per acre. Salt, however, should not be put upon the land when beets are cultivated as the raw material for the manufacture of sugar; the presence of common salt in the pressed juice of beet-roots greatly interferes with the extraction of saleable, crystallizable sugar.

Good farm-yard manure, guano, and all saline manures which greatly increase the produce per acre, therefore, have to be avoided either altogether, or to be employed with descrimination, and always in limited proportions.

Experience has shown that although more sugar may be grown per acre when the land is well manured than is the case when it is left in a comparatively speaking poor condition, it will not answer the requirements of the manufacturer of sugar to have to deal with roots that have been highly manured and yielded a heavy crop per acre, and in it much sugar, for beet-roots grown under these conditions are generally poor in sugar, and if the per centage in the roots sinks below 6½ per cent., it is impossible to extract from them the sugar profitably.

If, however, the sole object for which beets are grown is the manufacture of alcohol, it matters little whether the roots contain a high or comparatively low per centage of sugar, as long as the average produce per acre of sugar is large, for roots containing not more than 5 per cent. of sugar can, nevertheless, be profitably employed in the distillation of spirits. This is an evident advantage, inasmuch as it enables the farmer to supply distillers more profitably with heavier crops than he can do when the roots are wanted for the manufacturing of beet-root sugar.

If the soil is very poor, it is impossible to grow anything like a crop without manure; in that case farm-yard manure must be applied to the land in autumn, or 3 or 4 cwts. of guano, or a mixture of guano, bone-dust, and superphosphate and sulphate of potash. Peruvian guano has been used with advantage for beets on naturally poor soils, and when used in moderate quantities in autumn it greatly benefits this crop.

Sulphate of ammonia is also used on such land with considerable advantage for beets. Like guano, it should be applied to the land in autumn, and sparingly.

Ammoniacal salts, guano, rotten dung, and, in general, all nitrogenous manures, require to be used with discrimination, for their tendency is to encourage the luxuriant growth of tops, and to diminish the per centage of sugar in the roots. A certain amount of available nitrogen in the soil appears to be necessary for the healthy growth of the sugar-beet, and hence the use of guano, or sulphate of ammonia, or animal manures, cannot properly be condemned unconditionally, for, as just stated, these manures are beneficial to beets when the soil on which they are intended to be grown is either naturally very poor, or out of condition by repeated cropping. On the other hand, nitrogenous manures, such as guano, sulphate of ammonia, or rotten dung, should not be applied to beets when the land is in good heart. Soils in a good agricultural condition always contain a sufficient amount of available nitrogen to meet the requirements of that root crop, and an extra supply of nitrogeneous organic matter, or ready-formed ammonia on such land does harm, inasmuch as it both diminishes the per centage of sugar in the beets, and prevents the manufacturer obtaining, in a crystallized form, as large an amount of sugar as he can produce from beets containing the same per centage of sugar, but grown without the use of nitrogeneous manure.

Common salt, so largely applied to mangolds in this country, and nitrate of soda retard the ripening process, and, in consequence, act injuriously on sugar-beets. On the other hand, phosphatic manures favour early maturity.

Superphosphate of lime may, therefore, be applied to the land with excellent effect at the time when the seed is drilled in. Bone dust also does no harm, but good, to beets. On light soils, in which potash is generally deficient, a mixture of superphosphate and sulphate of potash has been found most serviceable to beets, in many cases, and can be thoroughly recommended, not only for light sandy soils, but upon all soils in a comparatively poor agricultural condition.

Time of sowing and distance of planting.—The season for sowing beet-roots extends from the beginning of April to the first week of May. Generally speaking, it is undesirable to sow earlier than the first week in April, nor is it well to delay it longer, if possible, than the first week in May. Sown too early in spring, the roots are very apt to run to seed during growth, especially if frosty nights should set in; and if delayed too long, the crop may not get fully ripe before it has to be taken up. On the whole, the middle of April is the best time for sowing beet-root.

Under ordinary circumstances the steeping of the seed in water can be dispensed with, but occasionally the steeping of the seed for twelve hours in water may be practised with advantage in advancing the growth of the plant.

As regards the quantity of seed used, it may be stated that in the north of Germany beet growers sow not less than 15 lbs. to the English acre, which is fully double the quantity of ordinary mangold seed usually sown in England.

A much larger quantity of seed is required, because beet-roots have to be grown more closely than mangolds.

Of course the distance between the drills and between each plant have to be regulated according to the various agricultural conditions in which the land may be, upon which it is purposed to grow this crop. The better the soil, the closer the roots may be grown. If grown too wide apart on good land, the beet-roots grow larger, but remain poor in sugar; and, on the other hand, planted too near each other, the roots get rich in sugar, but remain small, and the value of the produce in either case is less than when both extremes are avoided. Speaking generally, the distance between the rows and from plant to plant should not be less than 12 inches, nor greater than 18 inches.

After-Culture.—The after-culture of the beet, like that of the mangold and root crops generally, consist in timely and careful thinning, weeding, and keeping the soil in a loose and friable state, by means of the drill-harrow and the horse or hand hoe. As long as the young plants are not injured by hand-hoeing, the repeated application of the hoe from time to time will be attended with the greatest benefit to the crop, care being taken that the last hoeing is done so as to gather up the soil round each plant, in order that the head of the root may be completely covered.

During the last two years, many persons who have grown beets in this country have experienced a loss in the crops from their beets running to seed. This has been ascribed to the bad quality of the seed, or to the peculiarities of the soil on which they were raised. It is quite true that bad seed has the effect of causing beet-roots to run, but, at the same time, it is well to direct particular attention to the fact that the young plants when caught by a frost in spring, no matter however slightly, invariably run to seed. Should, therefore, the beet-root crops be attacked in spring by a night's frost, the best thing that can be done with them is to plough them up at once and to resow.

Maturity of Roots.—Beet-roots generally get ripe in about five months. When sown in the beginning of April, they will thus be ripe in an average season about the middle of September. However, much depends on the season and the character of the land in bringing the crop to maturity, and therefore the length of time during which the crop should be left in the ground cannot be expressed in general terms. The best time for taking it up is that when the roots are nearly ripe. This stage of development is recognised by most of the leaves turning yellow and flabby. As long as the tops are quite green and succulent, the roots will be found in a growing state, and as long as they continue to grow, sugar continues to be stored up in them. Should the weather be cold and no rain fall in autumn, the crop may be left in the soil without injury a week or fortnight after the roots are quite ripe. But should the autumn be mild and wet, every chance is given to the roots to make a second growth, which should be avoided by all means, inasmuch as the young leaves in that case are produced in a great measure at the expense of stored up sugar in the roots. Nothing does so much injury to the beets as a second growth of tops after the roots have become ripe, and hence the safest plan is to take them up as soon as possible after the crop has arrived at maturity. Particular attention, therefore, should be paid by the beet-root grower to watch the ripening process, and he will find it useful, during the latter stages of growth, to test from time to time the richness of the roots in sugar. This may done with sufficient accuracy for practical purposes, and with great ease, by grating a root or two, and squeezing out the juice by pressing the pulp through calico, and testing the specific gravity of the juice by means of a specific gravity float. The juice of beets, rich in sugar, has a specific gravity not lower than 1·07, and as long as the gravity of the beet-root juice continues to increase, sugar is still formed, and the roots should be left in the ground. A good indication of their maturity is afforded when a root is cut in two with a knife. If the newly-cut surfaces of the beet rapidly turn colour on exposure to the air, the ripening process is not completed; but if they remain unchanged, or turn only slightly reddish, it may be taken for granted that the beets are sufficiently ripe to be taken up. Immature roots sliced with a knife, rapidly turn first red, then brownish, and finally quite dark, on the surface touched by the knife.

Great care is needed in harvesting the crop, for the slightest injury to the roots is sure to be followed by a proportionate loss of sugar. To the farmer who uses the root for his cattle, this is of far less importance than to the manufacturer, whose main object is to extract as much sugar from the root as possible. When injured by careless manipulation in trimming or otherwise, fermentation is rapidly set up in the injured roots, the crystallizable sugar is converted into fruit-sugar or glucose, which does not crystallize, and is consequently lost. The crop should be taken up in fine dry weather, and especial precautions should be taken to guard the roots, when stored, against rain and frost. It is desirable that they should be exposed on the ground for three or four days before they are stacked, in order that they may lose as much of their moisture as possible.

The roots, however, should not be exposed for more than a few days to the air, and never to the sun. It is well, therefore, to cover temporarily the roots with their tops, in the field, before stacking.

Some farmers are in the habit of stacking the roots with the tops, but this is not a good plan, and it is far better to cut off the tops carefully without injuring the roots, and then to stack them. In storing beets, especial care should be taken to prevent germination and throwing out fresh tops. As light, heat, and moisture greatly favour germination, which is always attended with loss of sugar, the roots should be especially guarded against these injurious influences.

The most effectual plan to preserve roots in good condition is to select a dry and suitable locality, to pile the roots in pyramidal stacks, about 6 feet broad at their base, and seven feet high, and to cover the stacks immediately with dry earth. At first the roots should be covered but slightly with earth, in order that the moisture may readily evaporate, and subsequently when frost sets in, another layer of earth, not exceeding one foot in thickness, may be placed on the stacks. If at once a thick layer of earth is placed upon the roots, the moisture which they throw off cannot freely escape, and, in consequence, they are apt to heat and to suffer changes which diminish the amount of crystallizable sugar they contain.

Composition of Sugar Beets.—If we take a beet-root and cut it across, we shall see that it is composed of concentric zones or layers, differing in colour, more or less, according to the variety. The exterior, or skin, is composed of compact cellular tissue. Next will be seen concentric zones, the number of which corresponds with that of the several circles of leaves forming the tops, and the breadth of which depends on the stage of development of the leaves. The oldest and most external leaves are in direct communication with the oldest and most central layers or zones, composed of cellular and vascular tissue, whilst the youngest and most central leaves communicate with the most recent external concentric zones of the root, and provide them with nourishment.

If the leaves of a beet-root are very large and luxuriant, the concentric rings of the root with which they communicate will also be found very large, the tissue of their rings spongy, and the cells large and filled with sap, that is, comparatively speaking, watery and poor in sugar.

On the other hand, the less luxuriant and smaller tops of well-grown, moderate-sized beets will be found to correspond with concentric layers of cells of smaller dimensions and to be filled with a clearer sap, richer in sugar than we find it in roots with large tops.

The best roots for the manufacture of sugar are those in which the size of three concentric layers of cells does not exceed $\frac{1}{8}$th to $\frac{1}{4}$th of an inch. As a rule, such roots do not weigh more than 2 lbs. each; their flesh is more firm and less transparent than that of big heavy roots, which exhibit on a cross section large concentric zones or layers of cells, filled with a liquid much poorer in sugar.

The walls of the cells are composed of cellulose, and upon this is deposited a gelatinous matter, called pectose which occurs in all bulbous roots and in fruits, from which jelly can be obtained. Besides cellulose and pectose, constituting the bulk of the expressed pulp of beet-root, the latter contains small quantities of soluble albuminous compounds and insoluble mineral matters, chiefly composed of insoluble salts of lime. The liquid contents of the cells, or beet-root juice, contain in addition to sugar, their chief constituent, an appreciable amount of vegetable casein and analogous nitrogenous compounds, a little green colouring matter, oil, a peculiar acrid-tasting substance, which has not as yet been satisfactorily isolated, citric, and probably other organic acids, and a number of saline compounds which constitute the soluble portion of the ash of beet-root.

Many of the constituents of beet-root are present only in very minute quantities, and their determination in exact quantities is of little or no practical utility.

In the analytical investigations of a great number of beet-roots grown in England under a variety of conditions, I have, therefore, not considered it necessary to determine quantitatively all the various constituents of sugar-beets, but have confined myself to ascertain with accuracy the amount of

1. Water.
2. Crystallizable sugar.
3. Pectinous substances.
4. Albuminous or nitrogenous compounds.
5. Crude vegetable fibre (exhausted pulp).
6. Mineral matter (ash).

The relative proportions of these constituents varies a good deal in beets according to the soil, manure, season, and other circumstances which affect the character of the produce.

The following analyses of beet-root grown in England, may be considered as fairly representing the composition of English beets of superior quality.

Beet-roots grown in England.

	Suffolk.		Berkshire.	
	No. 1.	No. 2.	No. 3.	No. 4.
Water	83·11	83·43	81·28	81·71
Albuminous compounds*	1·25	1·53	1·24	0·98
Crude fibre (pulp)	3·43	3·49	4·01	4·02
SUGAR	10·51	10·04	11·87	12·02
Pectin, colouring matter, &c.	0·63	0·50	0·63	0·45
Mineral matters (ash)	1·07	1·01	0·97	0·82
	100·00	100·00	100·00	100·00
* Containing nitrogen	0·200	0·245	0·199	0·157
Weight of root	2¾ lbs.	2 lbs.	1 lb. 5 oz.	1 lb. 6 oz.

The preceding analyses agree closely with the following, mentioned by Mr. Payen in his "Traité de la distillation de la Betterave," as expressing the composition of white silesian beet of good quality grown in France:

Beet-root grown in France

Water	83·5
Albuminous compounds	1·5
Cellulose and pectose	0·8
SUGAR	10·5
Pectin, colouring and mineral matters	3·7
	100·0

In illustration of the composition of poor English beet, the next analysis may be quoted.

Beet-root grown in Suffolk.

Water	86.39
Albuminous compounds	2·13
Crude fibre	3.79
SUGAR	5·52
Pectin, &c.	0.75
Mineral matters	1·42
	100·00
Weight of root.	2 lbs. 11 oz.

Two varieties of Dutch roots on analysis yielded the following results:

Silesian Beet-roots grown in Holland.

	Purple Skinned Root.	Pink-Coloured Root.
Water	82·79	85·67
Albuminous compounds	1·12	1·91
Crude fibre	4·07	3·40
SUGAR	10·56	7·42
Pectin	0·45	0·33
Mineral matter	1.01	1·27
	100·00	100·00
Weight of root	2 lbs. 10¾ oz.	1 lb. 13¼ oz.

The first variety of the Dutch beet-root, it will be noticed, is much superior to the second. Both are not superior in sugar-yielding qualities to beets grown in England; still Holland is profitably growing beet-root.

Sewage of towns may be applied to sugar-beets with much advantage during spring in the earlier part of their growth. The supply of sewage should be stopped after July, or at the period when the tops are fully grown, and sufficient time (about three months) should be allowed between the last dressing of sewage and the harvest, to permit the elaboration of the crude plant juice into compounds, which, like sugar, are stored up in the fully ripe bulbous roots.

That beet-roots, rich in sugar as well as rather poor in sugar, can be grown with sewage, the following analyses will show:

Composition of Silesian Sugar-Beets manured with London sewage, Lodge Farm, Barking Creek.

	No. 1.	No. 2.
Water	80·79	87·94
Albuminous compounds	0·88	1·26
Crude fibre	3·32	3·08
SUGAR	13·19	6·05
Pectin, &c.	0·91	0·48
Mineral matter	0·91	1·19
	100·00	100·00
Weight of root	2 to 2¼ oz.	4 to 1 oz.

The following analyses of beet-root grown in Scotland prove that Silesian sugar beets can be grown in several places in Scotland with great success; for the beets grown in Scotland show as high an average per centage of sugar as those raised in England.

Silesian Sugar-Beets grown in Scotland.

Water	85·21	83·36	82·17	81·56
Albuminous compounds	0·93	1·41	1·47	1·50
Crude fibre	3·53	2·88	3·26	3·28
SUGAR	8·65	10·46	11·24	12·18
Pectin, &c.	0·44	0·83	0·84	0·57
Mineral matter	1·24	1·06	1·02	0·91
	100·00	100·00	100·00	100·00
Weight of root	1 lb. 1¼ oz.	3 lbs. 4½ oz.	2 lbs. 13½ oz.	3 lbs. 1½ oz.

The following analyses, of beet-roots grown in different parts of Ireland, show that beet-root distillation may be turned to great advantage in that country.

Beet-roots grown in Ireland.

Water	86·06	86·30	85·60	82·79
Albuminous compounds	1·66	0·83	1·47	1·50
Crude fibre	2·98	2·98	2·87	3·46
SUGAR	7·53	8·26	8·56	10·96
Pectin, &c.	0·44	0·44	0·54	0·46
Mineral matter	1·33	1·19	0·96	0·83
	100·00	100·00	100·00	100·00

As might have been expected, the roots with a high percentage of sugar contain less water than those poor in sugar. The relations between the percentage of water and sugar, however, are not exactly the same in the different roots, and the amount of water in a beet-root cannot, therefore, be regarded as indicating exactly the percentage of sugar which it contains.

Beet-root distillation.—The merit of having introduced into England the manufacture of beet-root sugar from home-grown beets, is due to Mr. Duncan, of Lavenham, who has striven to induce English farmers to turn their attention to the cultivation of sugar-beet.

Mr. Robert Campbell, of Buscot Park, Berkshire, deserves high praise for having recently established an extensive distillery, in which alcohol is produced from beet-roots grown on his own property. Great credit is due to Mr. Robert Campbell for the energy and discrimination which he displayed in erecting, in an incredibly short time, the necessary buildings, and providing the most improved stills which as yet have been invented for the production of pure alcohol from raw materials, from which formerly spirit largely contaminated with fusel oil could only be obtained.

It may be in the recollection of some of the readers of these pages that the distillation of mangolds was attempted in England some nine or ten years ago, and proved a complete failure. Any less enterprising man than Mr. Robert Campbell, for this reason, might well have been frightened in a fresh attempt to manufacture alcohol from roots.

During my residence at Cirencester, I have had the opportunity of watching the proceedings in a mangold spirit distillery, which was erected about ten years ago at Minety, a village a few miles from Cirencester, and which, like all other mangold spirit distilleries established at about the same period, after working for a short time, was obliged to abandon a business which turned out a complete failure.

Quite recently I have had an opportunity of paying a visit to Mr. Robert Campbell's distillery at Buscot, Berkshire, and to inspect carefully the magnificent distilling and rectifying stills, erected there by Messrs. D. Savalle and Co., of Paris, who, four years ago, sent to England their representative, Mr. James Barral, for the purpose of introducing beet-root distillation in Great Britain by means of their patent stills.

Having had good opportunities to compare the present arrangements for the production of spirit from roots with the appliances formerly in use in mangold-spirit distilleries, and having taken much pains to inquire into the various causes which lead to the previous failures, I may be allowed briefly to mention some of the reasons why the distillation of alcohol from roots could not be carried on profitably in former years.

In the first place, I would observe that the roots then employed by distillers were common mangolds, which, when grown to any considerable size, seldom contain more than 4½ per cent. of sugar, and often less, and as it is the sugar which produces alcohol on fermentation, and as the distillers paid as much as £1 per ton for common mangolds which were poor in sugar, a profitable return could hardly be expected.

In the next place, the ill-success was due, in a great measure, to the fact that the distilling and rectifying stills, in vogue ten years ago, produced an abominably smelling and tasting spirit, which could only be used for burning, or the making of varnishes and French polish, for which alcoholic spirits highly charged with fusel oil or methylated spirits are generally used, on account of their low price.

In other words, the distillers of mangold spirits employed a raw material, which is much inferior to beet-root in its sugar yielding, and consequently alcohol-producing properties, paying for it as much, and in some cases even more, than is given to-day for good sugar-beets, and they obtained a product which had to be sold at the lowest price at which impure alcoholic spirits can be bought.

At present the aspect of root-distillers has undergone a complete change.

Instead of common mangolds, Mr. Robert Campbell grows Silesian sugar-beets, much richer in sugar and alcohol-producing properties than common mangolds, and instead of the old-fashioned stills and imperfect plans of rectifying spirit then in use, Mr. Robert Campbell employs *the Distilling and Rectifying Savalle Stills, which, on the occasion of my visit, I saw in operation, and by means of which an extremely pure alcohol of very high strength, which cannot be distinguished from pure spirit-of-wine, is produced.*

Well rectified beet-root spirit at the present time is used by perfumers, liqueur-makers, chemists, &c., and for all purposes for which a pure alcohol, free from fusel oil or similar bye-product of fermentation is required, and there can be but little doubt that a good deal of "*Real French Brandy*" consumed in England and on the Continent, in point of fact, is nothing more or less than beet-root spirit deprived by the Rectifying Savalle Stills of all impurities which are found in raw spirit, and flavoured with a little real Cognac (about 20 per cent).

Mr. Robert Campbell last season converted 6,000 tons of sugar-beet into spirit-of-wine, and in the present expects to grow about 10,000 to 12,000 tons of beet-roots with the intention of distilling alcohol from them, and utilizing the residue or pulp for fattening purposes.

Amongst a number of competitors, Messrs. D. Savalle and Co. received the first prize, or Gold Medal for excellence and superiority of their stills at the Great Exhibition in Paris in 1867; in a report by M. J. Pezeyre, Secretary of the Society of Distillers at Paris, amongst other particulars gives the following account of the Savalle Stills.

Savalle Stills are applicable for all purposes of distillation and rectification, especially the latter. Of all distilling operations, the rectification of crude alcoholic liquids, and the production of pure and strong alcohol therefrom is the most difficult.

In point of economy and superiority of the products of distillation, Savalle Stills leave nothing to be desired. The principle upon which this apparatus is constructed rests on the difference in the specific heat of alcohol and the compounds with which it is associated in low wines, and the continuous separation and elimination of the various products of distillation.

A practical application of this principle is made in the Savalle Stills, which are so constructed that the crude liquids from which the alcohol is to be extracted are broken up in the most minute particles, all of which are brought in immediate contact with heat, and split up into the various products of distillation.

By an ingenious arrangement, every foot of surface in the Stills produces five times as great a useful effect as in any other kind of Still, and the alcholic vapours, purified by numerous washings, escape at one side, whilst the impure by-products of distillation, pass off in the opposite direction. *By these means great economy in time and fuel is effected in the production of pure spirit.*

The distilling and rectifying Savalle Stills are always heated by steam, which on account of its regularity and economy possesses an incontestable superiority over heating by naked fire.

The apparatus consists of a boiler, a distilling column, separating condenser, cooler, and a special reservoir for the reception of the fusel oils, and a steam regulator.

The distilling column consists of a metallic cylinder, fitted in the interior with a number of diaphragms which are placed one above the other, and so combined as to realize the greatest subdivision of the alcoholic liquids, and to present to the alcoholic vapours the, greatest obstacles for getting washed and separated into pure alcohol and fusel oil. On leaving the distilling column, the vapours enter the analyzing condenser; these mixed vapours, composed of water, alcohol, organic acids, various ethers, essential oils, and several species of carburetted hydrogens are submitted to a temperature which compels each of these bodies, in obedience to the law of their specific heat, to undergo a preliminary analysis, in consequence of which the densest bodies are thrown back into the distilling column, and the more volatile escape. The condenser communicates with the refrigerator which receives the volatile vapours, these vapours discharged under a fixed pressure, in expanding, meet with numerous points of contact in the apparatus which rapidly condense them.

The condenser and refrigerator are tubular, in conformity with the essential principle of the apparatus, that is to say the infinite subdivision of the heat, which allows the rapid change and instantaneous cooling in the condenser and refrigerator. The heating surface and the surfaces of the washing and analysing columns have been calculated in a mathematical proportion with the condensing surfaces of the condenser and refrigerator. In an unity of time and surface, quantities of work hitherto unknown are obtained. Well, this maximum of effect corresponds to a minimum of expense of fuel, force, time and water. For this reason, the Savalle Stills produce, per hour, five times as much alcohol as the other stills of the same dimensions, and with a constant perfection, and in the most economical manner.

The regulator is an essentially novel application of hydraulic laws, and has been introduced by Mr. Savalle in his Stills. Its purpose is to regulate all the forces and functions, and to maintain the phenomena which are produced in the different parts of the apparatus in a condition of uniform temperature and pressure, so indispensable for obtaining a rapid flow of good alcohol.

The operation, consequently, is never interrupted by excessive heat, over which there is no control in ordinary stills. *A Still without the Savalle steam-regulator is like a vessel without a compass, exposed to all chances of error and accidents.*

The tank for the collection of the fusel oil is placed below the column; it holds the heavy products of distillation, which are obtained during the rectification and prevented to become mixed with the alcoholic liquid in the boiler.

An improved distilling apparatus is necessary for the production of good spirit-of-wine, rum, and more particularly for the rectification of beet-root spirit, grain and potatoe spirit, and spirit from molasses.

The raw sugar in molasses represents the alcohol in low wines; sugar must be refined in order to become white and of a sweet and pure taste. Low wines have to undergo a similar refining process, known under the name of rectification. Well-refined beet-root sugar is identical with equally well refined cane-sugar, AND PERFECTLY RECTIFIED BEET-ROOT SPIRIT IS IDENTICAL WITH PURE SPIRIT-OF-WINE.

The rectification of alcohol has for its object to separate from it all foreign impurities. *By means of the Savalle Stills, alcohol is obtained from beet-root, of great purity, and of quality superior to ordinary spirit-of-wine.*

The purity of spirit-of-wine is only a relative purity, and is far from perfect in most cases. In fact, spirit-of-wine generally is a very complex mixture of Water, Ethyl-Alcohol, Amyl-Alcohol, various Ethers, Organic Acids, Aldehydes, Glycerine, Essential Oils and Hydrocarbons, of which little is known. These bodies, resembling each other in composition and general characters, are difficult to separate from another. In spirit-of-wine these bye-products of distillation are by no means disagreeable, but in the case of beet-root spirit it is absolutely necessary to remove them, in order to obtain a perfectly neutral and pure alcohol. If these foreign matters are only partially separated, the alcohol assumes a bad state by age.

The effect of these foreign substances upon alcohol is more energetic under the prolonged action of heat. Every attentive distiller knows full well how prejudicial to the quality of the spirit is the effect of a prolonged rectification. The alcohol produced during the first twenty-four hours is much finer, and more neutral, than that obtained after forty or fifty hours. Under the continued influence of heat and the hydro-carbons, acids and ether, the constitution of the alcohol is partially changed, and new products are obtained which have a bad taste and smell. It is as objectionable to work with slow acting Stills as with imperfect ones. The Savalle Stills meet these inconveniences by the great regularity and rapid progress with which the distillation proceeds.

With an ordinary still it is impossible to separate sufficiently well the foreign impurities from alcohol, but with the RECTIFYING SAVALLE STILLS, SPIRIT OF GREAT PURITY IS OBTAINED WITH CERTAINTY.

The Rectifying Savalle Stills are self-regulating, and produce as much as 90 per cent. of extra fine spirit of great strength (69° to 70° o. p.,) without the use of any chemical agents.

By operating in ordinary Stills, the loss of alcohol amounts from 4 to 8 per cent.; in the Rectifying Savalle Stills the loss is quite insignificant.

Distillers are too much interested in all improvements *for not generally adopting the use of the Savalle Stills, which have found their way in many of the largest establishments of France, Belgium, Germany, Spain, and the Colonies. Their introduction into distilleries may be considered as one of the best means for augmenting the prosperity of distillers.*

The refuse pulp which is obtained in beet-root distilleries is a valuable feeding material; it may be kept for any moderate length of time, and, according to the experience of French and Belgian feeders of stock, does not deteriorate, but improves in fattening properties when kept for a year or longer. It keeps remarkably well for a long period, and used with a little meal and chaff is an excellent food for fattening beasts.

The following analyses represent the composition of two samples of beet-root pulp, from Mr. Robert Campbell's distillery at Buscot:

Composition of Two Samples of Beet-root Pulp, or residue, from Mr. R. Campbell's Distillery, at Buscot, Berkshire.

	No. 1.	No. 2.
Water	85·35	87·40
Albuminous compounds (flesh forming matters)*	1·73	1·49
SUGAR	0·15	0·25
Pectin and digestible fibre	7·92	7·22
Woody fibre (cellulose)	2·64	2·65
Mineral matter (ash)†	2·21	0·99
	100·00	100·00
* Containing nitrogen	0·277	0.239
† Containing sand	1·77	0·32

As stated before, beet-roots containing less than 6½ per cent of sugar, I believe, cannot be profitably employed for sugar making, but such roots, nevertheless, may be usefully employed for the distillation of spirit.

A farmer, therefore, may grow sugar-beets for the use of the distillery on soils not particularly well adapted for beet-root culture, and under circumstances in which perhaps suitable roots for the sugar factory cannot be grown, and with comparatively little trouble and the employment of a small capital, unite the occupation of distiller with that of farmer, and reap the advantage of both pursuits.

The manufacture of sugar, on the other hand, cannot be carried out profitably on a small scale, and of necessity, therefore, can only be undertaken by well-managed companies or wealthy individuals who can give their whole attention to the intricate process of manufacturing and refining sugar; whilst the operation of fermenting the beet-root juice, distilling and refining the crude beet-root spirit by the Savalle Stills may be carried out by any man of moderate means and ordinary intelligence, for in a great measure the Savalle Stills may be said to be self-regulating.

Laboratory, 11, Salisbury Square, Fleet Street, E.C.
November, 1870.

OPINION OF JAMES HOWARD, ESQ., M.P., ON THE SAVALLE STILLS.

In his very interesting Paper on "Continental Farming and Peasantry," Mr. James Howard, M.P., the clever engineer of Bedford, devotes some pages to "Beet-root Culture: Sugar and Spirit," from which we quote the following:—

"The growth of beet for the manufacture of sugar and spirit forms the most important branch of farming in France, Belgium and Germany. It has proved to be such a source of national wealth to those countries that it naturally takes precedence of all other agricultural topics. There are now in France 470 beet-root sugar factories; in Belgium 116; and in Prussia 255. In Austria, Hungary, Russia and other parts of Europe, the process is also successfully carried on.

"To show the appreciation in which this branch of industry is held in France, at an agricultural meeting held a few years ago at Valenciennes, a triumphal arch was erected, on which appeared the following inscription: "The growth of wheat in this district before the beet-root culture was only 122,000 qrs., the number of oxen 700; since the introduction of sugar-beet the growth of wheat has been 146,000 qrs., and the number of oxen 11,500.

"In addition to the sugar factories I have alluded to, there are immense numbers of distilleries for extracting spirit from the beet. In France the number reaches five hundred. The distilling of spirit is said to be far more profitable than the manufacture of sugar. On many farms both processes are carried on, and a few years ago many sugar factories were converted into distilleries. I learned the other day, from a French engineer interested in the new Patent Savalle Stills, that he is engaged in the erection of a large distillery near London, for extracting spirit from beet-root. The whole cost of the distillery is estimated at £16,000. As the parties are people of experience, they have doubtless satisfied themselves that the difficulties experienced by other persons are to be overcome. Hence the question as to making spirit from beet-root being a profitable process will speedily be put at rest."

In a second edition of his paper Mr. Howard put in note :—

"The beet-root distillery referred to by me as being in course of erection, the locality of which I was not at the time at liberty to name, I am now permitted to state is being erected for Mr. Robert Campbell, of Buscot Park, Berkshire, and the engineer is Mr. James Barral, of 10, Basinghall Street, London, the son of the eminent French agriculturist, Mons. J. A. Barral, the proprietor and editor of the *Journal de l'Agriculture.* Mr. James Barral, representative of Messrs. D. Savalle and Co., the inventors of the Savalle Stills, has made beet-root distilleries his study, and he authorises me to say he will be happy to give full particulars to any who may be interested in the subject."

On the occasion of Mr. J. Howard's paper on Continental Farming and Peasantry, read by him on the first monthly meeting of the Farmers' Club, on Monday, November 1st, 1869, we wrote to him the following letter :

"London, 10, Basinghall Street, E.C.
"18th November, 1869.

"Dear Sir,

"You know that my father, the founder and editor of the *Journal de l'Agriculture*, is a French scientific authority, and that he for more than twenty-five years has devoted his time and intelligence to agriculture at large, and especially to that of France; well, my father, and I, who try to follow his good example, find your paper on Continental Farming very instructive and interesting. You have been clever enough, in spite of difficulties, to inquire into and judge everything; your countrymen ought to be proud of what you say of them.

" But allow me to tell you that there is a part of France, *the north,* where we obtain in wheat or other crops as much per acre as you obtain in England, and where, besides that, we grow beet-root either for spirit or sugar making. Grant us, at least, this superiority of producing on our soil our own sugar and extracting spirit from a new source.

" Is it not astonishing that sugar from beet-root is manufactured in England since two years only, and in but one factory, and that spirit from beet-root is about to be produced for the first time by Mr. Robert Campbell, of Buscot Park?

" Why did not the cultivation of beet-root for spirit or sugar-making hitherto succeed in England? Because the first experiments were made with a wrong species of roots; because the apparatus employed for distilling the roots were bad.

" If not in every part of England, in many parts, at least, the soil and the climate suit the growth of sugar-beet. Mr. Duncan has proved it in Suffolk; Mr. Robert Campbell is now proving it in Berkshire; somebody will one day prove it in your own county of Bedfordshire.

" At Buscot Park, on the splendid estate so intelligently cultivated. by its owner, Mr. Robert Campbell, one of the cleverest men of your fine country, the average richness of beet is 10 per cent. of sugar, which is what the best French beet-roots contain. I have myself made more than forty analyses of beets from Buscot Park, and I assure you that they are of prime quality. But the growth of sugar-beet is only the first point; the next is to obtain spirit or sugar. Well, spirit-making is much more profitable than sugar-making, for two reasons :—

" 1st. Because nearly all the sugar can be extracted in the state of spirit, whilst only two-thirds can be obtained in sugar.

"2nd. Because the cost of the plant of a distillery is half that of a sugar factory, and distillation is a very simple operation, whilst sugar-making is very complicated.

"About five or six trials of beet-root distillation have been made in Great Britain, and failed, undoubtedly in a great measure through the stills employed. But if British agriculturists get the proper stills, *the Savalle stills*, of which I am proud of being the introducer into England, they will obtain a finer and purer spirit than the grain spirit produced in England. Messrs. D. Savalle and Co., of Paris, had the honour of introducing beet-root distillation into Austria, and the spirit produced by their stills in France, Spain or Germany, obtain on the markets much higher prices than any other spirits. Nearly all the agricultural distilleries are now erected with these stills, and the large distillery of Mr. Robert Campbell, which will be the largest in the world, will prove again that the Savalle Stills are the best.

"The British agriculturists must bear in mind that an agricultural distillery is not merely a spirit factory, but a food, a manure factory. By the distillation of beet-roots, carbon, oxygen and hydrogen are extracted in a valuable state, which constituents are obtained more cheaply in hay, straw, oil-cake, &c.; so agriculturists would find it highly profitable to distil the beet, and give the residue or pulp to the stock, this is a cheap food, and an agricultural distillery is in fact a profitable factory, yielding good food and manure in addition to valuable spirit.

"It was on reading in the agricultural papers that you will give an appendix to your remarkable publication on Continental Farming, that I conceived the idea of writing this letter, and I hope you will find it interesting.

"In conclusion, I beg to say that I shall be happy to give any further information on this subject, and answer the queries of any person interested in the distillation of beet.

"I am, dear Sir,
"Yours faithfully,
"JAMES BARRAL."

In answer to the preceding letter we had the following reply, and beg to be allowed to give communication of it to our readers:

"Britannia Iron Works,
"Bedford, 26 Nov., 1869.

"Dear Sir,

"I duly received your letter of the 18th inst, and told Mr. Delano to acknowledge its receipt.

"I am aware of the high cultivation of the north of France, and I made prominent mention of it as also of your superiority in producing your spirit and sugar from your own crops.

"Spirit from beet-root will not first be produced in England at Buscot, Le Play's system was in operation at Birmingham from 1856 to 1859, also in Sussex. There have been many many attempts, I hope and believe you will succeed at Buscot, for you have undoubtedly better appliances, (the Savalle Stills), than those hitherto introduced in England.

"I am, yours very truly,
"James Howard."

To the above letter we answered by the following:

"10, Basinghall Street,
"London, 29th Nov., 1869.

"*To James Howard, Esq., M.P.*"

"Dear Sir,

"I am very much obliged for your kind letter of the 26th inst. received this morning.

"Allow me to say that I know perfectly of the different trials made in England for the distillation of beet-root by means of Le Play's or Champonnois' systems; but I do not call that the first introduction in England, because they had no success.

"I will call first introduction of beet-root distillation, or if you prefer first success of beet-root distillation, when success follows the trials, which has not been the case till to-day.

"Believe me, dear Sir,
"Yours faithfully,
"James Barral."

ON THE SAVALLE STILLS.

By WILLIAM CROOKES, F.R.S.,

Editor of " The Chemical News."

FROM HIS WORK ON THE "MANUFACTURE OF BEET-ROOT SUGAR".*

In Chapter XI devoted to the " Manufacture of Spirit from Beet-juice," Mr. William Crookes says:

" Although the greatest attention has been paid to the employment of the beet-juice for the purpose of extracting sugar from it, there is another profitable use to which it may be put which should not be overlooked, and that is, the production of spirit from it by fermentation.

" Mr. James Howard, M.P., who has collected much information on the subject of beet-root culture during a recent continental tour, says that, in addition to the sugar factories, there are immense numbers of distilleries for extracting spirit from the beet. In France the number reaches 500. The distilling of spirit is said to be far more profitable than the manufacture of sugar. On many farms both processes are carried on, and a few years ago—stimulated by the high price of raw spirit, the result of the wine disease—many sugar factories were converted into distilleries.

A French engineer, interested in a new patent still (the Savalle Stills), reports that he is engaged in the erection of a large distillery, near London, for extracting spirit from beet-root; the whole cost of the distillery is estimated at £16,000. As the partners are people of experience, they have doubtless satisfied themselves that the difficulties experienced by other persons are to be overcome; hence the question as to making beet-root spirit being a profitable process will speedily be put at rest.

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* " Manufacture of Beet-root Sugar." Longmans & Co. London. 1870.

"Mr. Robert Campbell, a wealthy and enterprising agriculturist, has erected a large beet-root distillery on his estate at Buscot Park.

"This agricultural establishment comprises about 5,000 acres of land, and the distillery supplies sufficient refuse to feed 12,000 sheep and 2,500 oxen. Mr. Robert Campbell has obtained, on the first trial, about 40 tons of beet-root to the acre, and these roots, on analysis, have been found to contain from 10 to 12 per cent. of sugar.

"The steam ploughs employed by Mr. Campbell are on Mr. Fowler's principle. They are capable of turning over the soil to the depth of more than three feet, and each of them can prepare about 25 acres in twenty-four hours. Mr. Robert Campbell estimates the cost of steam ploughing at about 2*s.* per acre, whilst with horses or oxen the ploughing would cost nearly 10*s.* per acre.

"The beet juice is extracted by M. Collette's system of presses, of which nine are already set up, and there are facilities for the erection of twenty. The nine presses extract the juice from 98 tons of beet in ten hours. The fermenting vats contain above 6,000 gallons each.

"The vast space allotted to machinery is occupied this year by two enormous stills (Savalle Stills), and a rectifier on the French system (Savalle Rectifier), and there is room for doubling* the apparatus in course of time. Mr. Robert Campbell has also added to the buildings a magazine consisting of vast metal cisterns capable of containing all the alcohol produced in one season. The spirit is thus stored without fear of leakage or evaporation till a good market price is obtained.

"Since the foregoing was written, we have been informed that the beet-root distillery on Mr. Robert Campbell's estate in Berkshire, was erected by Messrs. D. Savalle and Co., their agent in England being the French engineer mentioned on page 229, Mr. James Barral, of 10, Basinghall Street, London.

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* Mr. Robert Campbell has since ordered two more Savalle Stills, which makes five Savalle Stills in Mr. R. Campbell's distillery in Berkshire.

"The Savalle system for beet-root distillation appears to be of later date, and even more complete than the other systems, and it has been satisfactorily tested by the success Mr. R. Campbell has obtained with it. These stills produce spirit of perfect purity, and are arranged in accordance with the excise regulations.

"As we have already stated, beet-root distillation is superior to sugar-making when the roots contain only 5 per cent. of sugar, or too many salts to admit of their being properly refined.

FROM THE "FOOD JOURNAL."

"We have received from Mr. James Barral a Report of some very practical results from the Beet-root Distillery erected by Mr. Robert Campbell, Buscot, near Faringdon. The machinery is that of Messrs. Savalle and Co., of Paris, who undoubtedly have a speciality for excellence and economy in the construction of this class of engineering works. The specimens sent us by Mr. James Barral consist of a very pure beet-root spirit (68·8 o. p.,) some verbena scent made by the help of the same, and, what is better than all during this hot weather, a large bottle of milk punch, in which the beet-root spirit was again the principal component. There can be no doubt whatever that, in addition to the sugar and other useful products, as detailed in our article on "Beet," in the third number of this Journal, the distillation of the root will, in due course, play an important part in the economical resources of the country.

("*Food Journal,*" 1*st August,* 1870.")

IS BEET-ROOT DISTILLATION PROFITABLE?

To this question, "Is Beet-root Distillation profitable?" we will not reply by fine phrases describing what were farms and countries before Beet-root Distillation, and what they are now; only with two or three balance-sheets taken from Distillers' Account Books, we will show what are the profits yielded by Beet-root Distilleries.

On the six following pages, we give the estimate cost of three different sized distilleries and their balance sheets.

The Distillery No. 1, which costs £4000, requiring besides a capital of £2000 for its good working, and distilling the crop of 125 to 150 acres, gives a yearly profit of £2000, viz: 33 *per cent of the capital.*

The Distillery, No. 2, costing £7000, requiring £3000 for its good working, and distilling the crop of 250 to 300 acres, brings in £4000 a year, viz.: 40 *per cent of the capital.*

The Distillery, No. 3, of which the cost is £10,000, and the working capital £4000, distilling the crop of 500 to 600 acres, gives a profit of £9000 a year, viz.: 64 *per cent of the capital.*

No. 1.

ESTIMATE

Cost of a Beet-root Distillery working 20 *weeks in the year at the rate of* 120 *tons a week ;* 2400 *tons of Beet a year giving about* 48,000 *Gallons Spirit proof, being the crop of* 125 *to* 150 *acres.*

	£
2 Steam generators, 30 horse-power	300
1 Steam engine, 10 horse-power	120
1 Washer	24
1 Crusher and extra drum	92
2 Presses	36
2 Pumps	30
2 Strainers	24
1 Mixer	20
4 Fermenting vats	50
Savalle Stills (in iron and copper)	1060
Cisterns	96
Pipes, cocks and transmissions	414
	*£2266
Building, carriage and erection of machinery, &c.	1734
Total	£4000

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* IMPORTANT.—The plant of such a distillery, to do the same work in 20 weeks, in countries where the Excise regulations do not exist, would be only £1,000, supposing the diffusion or maceration be used instead of the presses. Even with the presses, the cost is very much less for the plant of distilleries erected on the Continent or the Colonies.

No. 1.

BALANCE SHEET

Of a Beet-root Distillery to work a Crop of 125 *to* 150 *acres.*

Cost of such a Distillery including building, plant, and everything else	£4,000
Capital required for working expenses	£2,000
Total Capital . . .	£6,000

Dr.	£	s.	d.	Cr.	£	s.	d.
To 2400 tons of Beet at 14*s.* 5*d.* . . .	1730	0	0	By 1440 tons of Pulp at 8*s.*	576	0	0
,, 168 tons of Coal at 20*s.* . . .	168	0	0	,, 48000 gallons of spirit proof at 1*s.* 10*d.* per gallon proof . .	4400	0	0
,, 1 ton 14 cwts. Acid at 1*d.* per lb.	15	17	4				
,, Labour	144	0	0				
,, Various expenses, interest, etc. .	270	0	0				
,, Storage	240	0	0				
	£2567	17	4				
Balance	2408	2	8				
	£4976	0	0		£4976	0	0

	£	s.	d.	
Profit	£2408	2	8	
Unforeseen Expenses .	408	2	8	
Nett Profit . .	£2000	0	0	or **33 per cent.**

No. 2.

ESTIMATE

Cost of a Beet-root Distillery working 20 *weeks in the year at the rate of* 240 *tons a week;* 4800 *tons of Beet a year giving about* 96,000 *Gallons Spirit proof, being the crop of* 250 *to* 300 *acres.*

	£
2 Steam generators, each of 70 horse-power	640
1 Steam engine of 20 horse-power	300
1 Steam engine of 6 horse-power	88
1 Washer	60
1 Crusher	80
1 Extra drum for crusher	20
5 Presses	900
2 Pulp pumps	120
2 Strainers	24
1 Mixer	28
6 Fermenting Vats	108
Savalle Stills (in iron and copper)	2080
	*£4448
Building, carriage and erection of machinery, &c.	2552
Total	£7000

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* IMPORTANT.—In countries where there is no Excise regulations, the plant of such a beet-root distillery would cost only £2,000.

No. 2.

BALANCE SHEET

Of a Beet-root Distillery to work a Crop of 250 to 300 acres.

Cost of such a Distillery including building, plant, and everything else	£7000.
Capital required for working expenses	£3000.
Total Capital	£10,000.

Dr.	£	s.	d.		£	s.	d. Cr.
To 4800 tons of Beet at 14*s.* 5*d.* . . .	3460	0	0	By 2880 tons of Pulp at 8*s.*	1152	0	0
,, 336 tons of Coal at 20*s.* . . .	336	0	0	,, 96000 gallons of Spirit proof at 1*s.* 10*d.* per gallon proof . .	8800	0	0
,, 3 tons 8 cwts. Acid at 1*d.* per lb.	31	14	8				
,, Labour	250	0	0				
,, Various expenses, interest, &c . .	500	0	0				
,, Storage	480	0	0				
	£5057	14	8				
Balance	4894	5	4				
	£9952	0	0		£9952	0	0

	£	s.	d.	
Profit	£4894	5	4	
Unforeseen Expenses .	894	5	4	
Nett Profit .	£4000	0	0	or **40 per cent.**

No. 3.

ESTIMATE

Cost of a Beet-root Distillery working 20 *weeks in the year at the rate of* 480 *tons a week;* 9600 *tons of Beet a year giving about* 192,000 *Gallons Spirit proof, being the Crop of* 500 *to* 600 *acres.*

	£
2 Steam generators of 90 horse-power	880
1 Steam engine of 20 horse-power	300
1 Steam engine of 8 horse-power	104
1 Steam engine of 1 horse-power	72
1 Washer	48
2 Crushers	164
6 Presses	960
5 Pumps	280
2 Strainers	24
1 Mixer	28
6 Vats	143
1 Reservoir	170
Savalle Stills (in iron and copper)	3350
Pipes and cocks	512
	*7035
Building, carriage and erection of machinery, &c.	2965
Total	£10,000

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* Important.—In countries where the Excise regulations do not exist, the plant of such a beet-root distillery would be only £3,500.

No. 3.

BALANCE SHEET

Of a Beet-root Distillery to work a Crop of 500 to 600 acres.

Cost of such a Distillery including building, plant and everything else	£10,000
Capital required for working expenses	£4,000
Total Capital . . .	£14,000

Dr.	£	s.	d.	Cr.	£	s.	d.
To 9600 tons of beet at 14*s*. 5*d*. . . .	6920	0	0	By 5760 tons of pulp at 8*s*.	2304	0	0
,, 672 tons of coal at 20*s*.	672	0	0	,, 192,000 gallons spirit proof at 1*s*. 10*d*. per gallon proof	17600	0	0
,, 6 tons 8 cwts. acid at 1*d*. per lb. .	59	14	8				
,, Labour	400	0	0				
,, Various expenses, interest, &c. .	800	0	0				
,, Storage	960	0	0				
	£9811	14	8				
Balance	10092	5	4				
	£19904	0	0		£19904	0	0

	£	s.	d.	
Profit	£10092	5	4	
Unforeseen Expenses .	1092	5	4	
Nett Profit .	£9,000	0	0	or **64 per cent.**

Supposing that for some reason or other (higher price of beet-root, bad crop of beet, low price of spirit, &c.), we reduce the profit by one-half, the three above distilleries still would leave a yearly profit of:

No. I	16 per cent	yearly profit.
No. II . . .	20 "	
No. III . . .	32 "	

We therefore simply ask our readers the question:

IS BEET-ROOT DISTILLATION PROFITABLE?

and leave the answer to them. We would observe, however, that no such profit can be obtained with a smaller distillery than No. 1, and with less capital than £6,000.

It is only on condition that the crop of at least 125 acres be distilled that beet-root distillation is profitable; smaller distilleries have and will always be failures.

There is no necessity to give here a detailed description of a beet-root distillery, suffice it to say, that the working of a beet-root distillery fitted by Messrs. Savalle & Co can be carried on by any country labourers.

We will only give a section and plan of a beet-root distillery, also illustrations of the Savalle Stills, pages 76, 77, 78, 79.

Since nothing is easier to work than a beet-root distillery, the most important points are the cost of a complete distillery and its balance-sheet.

BEET ROOT DISTILLATION AND SUGAR MAKING.

The production of pure spirit by distillation of beet-root is one of the most remunerative systems of farm labour; it furnishes spirit which is free from fusel oil or empyreumatic oils and finds a ready market. The object of this part is to make known the great advantage of the cultivation of sugar-beet for spirit making.

When beet-roots are employed for sugar making, the pulp obtained after pressing out the juice is a valuable cattle food; but some inconveniences accompany the employment of this residue, for it is produced in quantities too considerable to be used where it is produced; for it is impossible to work profitably sugar factories on so small a scale which will allow the pulp to be consumed on a farm attached to the factory. We must, therefore, necessarily store up the pulp and transport it towards local establishments more or less distant from the manufactory; expenses are thus incurred for storing and carting, besides the interest of the funds employed in this storing. In fact, the working of sugar factories has not up to the present time been able to be prolonged with profit beyond three months and a half, or four months, nor can it consequently occupy the labourers during all the interval between the most active operations of tillage.

But the case is totally different with beet-root distilleries, especially if we adopt a method similar to that described in this notice. Then, in fact, we can easily proportion the production to the wants of a great or middle-sized farm, or many farms of small extent, grouped near to each other, which would furnish the raw material for the operations of a beet-root distillery. The distillation may be carried on one of the farms, or in a central distillery, and the farmers can, in turn, be supplied with the residues; these latter distributed daily to the cattle, would not require the construction of store-houses to lay in any stock. The operations in the distillery may be continued without inconvenience, or rather with advantage for more than seven months, that is to say in general from the beginning of October to the middle of May; or, in other words, from the period when green food cannot be obtained till such food can be procured again, an interval of time during which labour is abundantly procured in the country. For this reason the production of spirit is, in this case, subordinate to the daily consumption of the pulp on the farm, so that we can consider the commercial produce (the spirit) as necessary, but the residue or agricultural produce as the principal object of distillation. In fact, with a view of well managing all economical conditions, we would not increase the manufacture of the spirit, nor reduce it, whatever the commercial price might be, *rising or falling*, for even when its price would be reduced one third, the farmer can continue with advantage the distillation of beet-root, while the grain distiller would not find it profitable to distill. (See page 123.)

Another great advantage of beet-root distillation over sugar making is the simplicity of spirit making; the quantity of sugar in beet-root varies from four to fifteen per cent of the total weight of the roots, and this causes a similar variation in the returns of spirit, which must be remembered, is entirely dependant upon the quantity of sugar contained in the raw roots. The cost of extracting the juice, of fermenting and distilling being nearly the same for an equal weight of roots, it is evidently the interest of all producers to procure either by their own cultivation, or from other growers, beet-roots containing the most sugar; these give weight for weight, not only the best spirits, but also the best residues for food. As we said before, the different varieties of seed, the soil, the manure, the cultivation, and the climate, have great influence in the yield of sugar and, consequently, of spirit. The best variety of beets, known up to the present time, is the red skinned white silesian beet, it gives weight for weight two or three times more sugar than the other classes of mangolds, and one and a half more than any other variety of sugar-beets. The soil and climate of many parts of Great Britain are most favourable to sugar-beet cultivation; as to manure and cultivation, no where in the world could a country be found where first class manure and able agriculturists succeed better; on Mr. Robert Campbell's Estate at

Buscot in Berkshire, beet-root cultivation and distillation have recently met with great success; and why success has been so tardy in this country is explained in Dr. Volcker's Report, page 40.

In the various systems generally in use for distillation, the fermentation is obtained by making use of a substance called yeast, a kind of fermented matter produced in excess by the fermentation of malt worts, consisting of saccharine liquids prepared by the germination of corn, especially barley, and the saccharification of the amylaceous substance, by means of the active vegetable principle, *diastasis*, which germination has developed. Every one knows that it is by this fermentation that the sugar is transformed into alcohol and carbonic acid. To arrive at this decomposition of sugar, the fermentation must take place under favourable but simple circumstances, consisting in the proper quantity of water, and the proper temperature. Chemically speaking, what is fermentation? We can say that it is the transformation of the sugar of beet-root into glucose, a kind of sugar containing an additional equivalent of water, and so an augmentation of weight results; and when the sugar is converted into glucose, the decomposition of the glucose commences, the result of which is alcohol which dissolves in the liquid and carbonic acid which goes out in the state of gas. The sugar contained in beet-root is crystallizable and identical to that of cane, but in that state cannot be decomposed into alcohol and carbonic acid.

By the following table the chemical reaction can very easily be understood :—

	Composition of Beet-root sugar.	Composition of the glucose resulting from the transformation.	Products after the fermentation.	
			Alcohol.	Carbonic Acid.
Carbon	$12C=72$	$12C=72$	$8C=48$	$4C=24$
Hydrogen	$11H=11$	$12H=12$	$12H=12$	
Oxygen	$11O=88$	$12O=96$	$4O=32$	$8O=64$
Total weight	171	180	92	88
			180	

That is to say, beet-root sugar + water = 180 = glucose = alcohol + carbonic acid, or,

$$C^{12}\,H^{11}\,O^{11} + HO = C^{12}\,H^{12}\,O^{12} = 2\,(C^{4}\,H^{6}\,O^{2}) + 4CO^{2}$$

Thus, 171 of sugar produces 180 of glucose, from which 92 of pure alcohol and 88 of carbonic acid; so if 171 of sugar gives 92 of alcohol, 100 of sugar produces 53·8; or, in other words, supposing no loss of spirit in the operations, one ton of beet-roots, containing 224 lbs. of sugar, would give 120 lbs., or 14 gallons of pure spirit, at the temperature of 59° Fahr., gallon proof. Practically, it is impossible to obtain the whole of the sugar contained in beets; but it is very useful to know the real quantity that ought to be obtained, so as to ascertain if the process employed for the extraction is sufficiently good in giving as near as possible the theoretical quantity.

The object of the distillation is to separate the spirit formed in the act of fermentation from the great quantity of water which is indispensable to the fermentation itself, that is to say, to the decomposition of sugar into alcohol and carbonic acid. Nothing is easier than distillation, by which is produced spirit more or less strong, more or less pure, but never quite pure. It remains to refine the spirit as the sugar itself requires to be refined; this is called rectification. Till the present time, such purification or rectification of spirit was very difficult, and could not be made except by able men, knowing perfectly that branch of industry; but, thanks to the stills invented and manufactured by Messrs. D. Savalle and Co., of Paris, such is no longer the case. Any one can produce with their stills the finest spirit, any country labourer after a few days can be a very clever distiller—it is why the distillation of beet-root is now so profitable on the Continent. Beet-root distillation is very profitable, because it produces very cheap food for cattle, but on this condition, that the spirit obtained will be marketable; for it is the sale of this spirit which gives to the farmer a profit, leaving on his farm the pulp, the value of it covering the expenses of extracting the spirit from the raw beet. *So the importance of rectification is great. Good rectification finds a ready market for the spirit produced on the farm.*

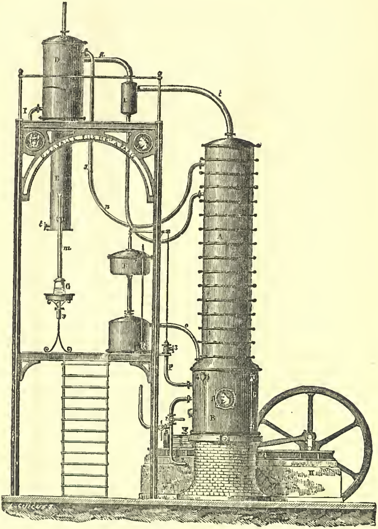
The object of rectification is to eliminate several compounds, having a very disagreeable odour and a very bad taste; some of those compounds are more volatile than ordinary alcohol, while others are very sensibly less volatile; the most volatile, of which much remains yet to be made known, has a great analogy with extremely volatile ethers; which carry over with them an essential oil or aromatic matter, the odour of which strongly resembles that of beetroot, this proceeds, undoubtedly, from a secretion peculiar to this root; the odorous and bitter principles, less volatile matters than the alcohol, require, in order to pass into and be kept in vapour a temperature much higher than ordinary alcohol, are of a complicated composition; they are formed of liquids volatile at different temperatures, from 185° to 270° Fahrenheit, analogous to vegetable essences; some appear to pre-exist in the root, while the most abundant of them is one of the products of the fermentation; it is found, in spirits of different origin, as in grain spirit. The name of amylic alcohol has been given to it; it is also called essence of potatoes; at 59° it is a colourless liquid, lighter than water, from which it separates as an oily stratum; its specific gravity is 815, (the specific gravity of water being 1000); its odour is pungent and disagreeable, and its taste is bitter and fiery. This liquid, like the essential oils, renders paper translucid by forming oily spots; but these disappear, and the paper resumes its opacity when this oily alcohol has evaporated. When heated up to 140° Fahrenheit, it is easily inflamed on the approach of a matter in combustion. The vapour of amylic alcohol is more than three times as heavy as air, its specific gravity is 3150, (specific gravity of air being 1000.) This sort of essence can be solidified at a low temperature; it takes the shape of crystalline plates when the temperature is as low as 4° Fahr., its composition is $C^{10} H^{12} O^{2}$. Amylic alcohol is largely soluble in common alcohol and in hydric ether. It dissolves sulphur, phosphorus, bromine, and iodine; the prolonged action of the oxygen of the air transforms amylic alcohol into valerianic acid, a very fluid colourless liquid, of a strong odour of valerian, it has a bitter and burning taste. Such are amongst others the unwholesome compounds to be separated in obtaining pure alcohol by rectification.

But nothing is easier than beet-root distillation, and the proof of it is the large number of farmers who on the Continent have a distillery on their premises, working under their own superintendance with the labourers of their own districts. Messrs. D. Savalle & Co. not only erect beet-root distilleries, but show how to work them. On the following pages we give cuts of the Savalle Stills, and of a beet-root distillery. The operations in a distillery fitted by Messrs D. Savalle & Co., are very simple, the beets are brought to a washer, to clean the beets of all dirt and stone, after that they are crûshed, and then pumped in the presses. By the presses the juice is extracted and runs to the fermenting vats, the pulp falls from the presses into carts to be sent to the cattle or to be stored. The juice is left to ferment a certain number of hours; the wash, the result of the fermentation, that is to say the liquid containing the sugar transformed into alcohol, is pumped into the stills, and a few hours after a pure spirit is obtained. Any persons comtemplating beet-root cultivation ought to visit a beet-root sugar factory, and a beet-root distillery to be convinced at once of the difficulty of the one and of the facility of the other.

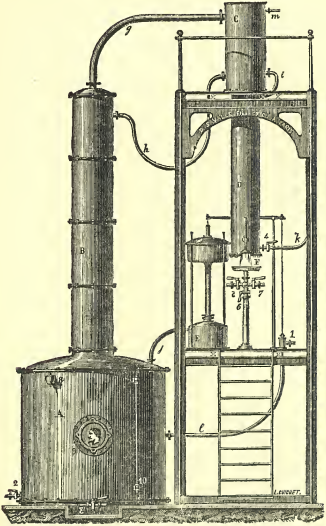
Some persons prefer the diffusion instead of the press; that is to say, that the beet-root, after having been cut in slices, are sent to macerate, and from thence the juice is sent into the fermenting vats.

Mr. Robert Campbell adopted first the presses, and now he has altered his distillery in introducing the maceration or diffusion. Messrs. Savalle & Co. have invented a very valuable disposition for beet-root distilleries by maceration, as shown on pages 80 and 81.

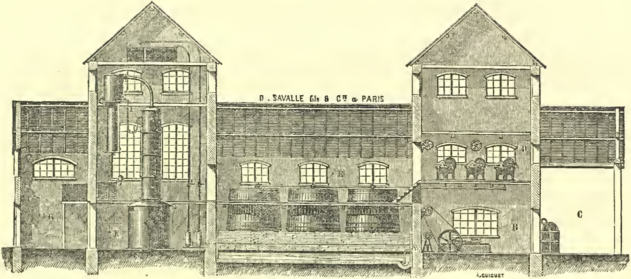
In beet-root sugar factories very expensive plant and many chemical agents are required, and the operations are very complicated and delicate; in fact, to extract the sugar: *lime, animal charcoal, crushers, hydraulic presses, defecating boilers, two series of filters, evaporating apparatus, syrup and molasses reservoirs, crystallisers, drying furnaces, &c.*, are in use, besides a vast number of smaller utensils, all arranged in vast buildings many stories high; on the contrary, to set up a new distillery on the ground floor, we only require a very simple and comparatively cheap erection, as shown on pages 100 to 106.



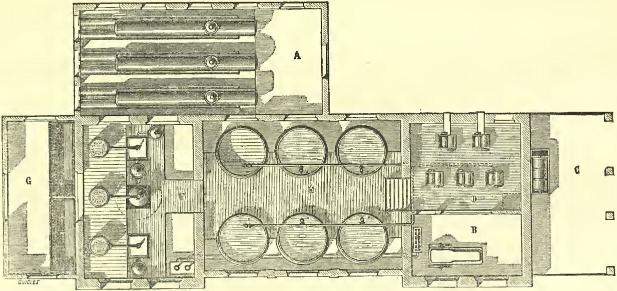
Distilling Savalle Still, into which the wash or fermented juice of beet-root is sent continuously to give low wines, which are then sent to the rectifying still. A. is the Column; B. Boiler; C. Froth-purger; D. Condenser; E. Refrigerator; F. Steam regulator; G. Gauging Spirit Prover.



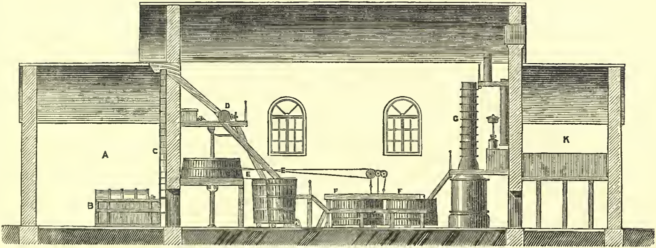
Rectifying or Refining Savalle Still is the second part of the Savalle Stills, in which the low wines are sent and distilled into extra fine spirit. A. is the Boiler; B. Column; C. Condenser; D. Refrigerator; E. Steam regulator; F. Gauging Spirit Prover.



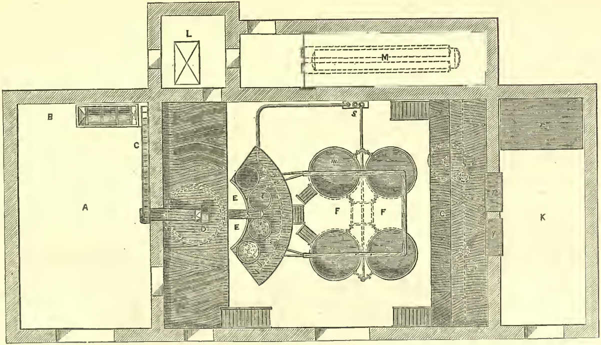
Section of a Beet-root Distillery as erected by Messrs. D. Savalle and Co., when the juice is extracted by presses.
B. Steam-engine; C. Washer and Crusher; D. Presses; E. Fermenting Vats; F. Savalle Stills; G. Cisterns for Spirit.



Plan of a Beet-root Distillery as erected by Messrs. Savalle & Co., when the juice is extracted by presses. A. Steam Generators; B. Steam-engine C. Washer and Crusher; D. Presses; E. Fermenting Vats; F. Savalle Stills; G. Cisterns for Spirits.



Section of a Beet-root Distillery, as erected by Messrs. Savalle & Co., when the juice is extracted by maceration or diffusion: A. Store-room for Beet-root; B. Worker; C. Beet-root elevator; D. Crusher; E. Maceration or Diffusion, F. Fermenting Vats; G. Savalle Stills; K. Store-room for Spirit.



Plan of a Beet-root Distillery, as erected by Messrs. D. Savalle & Co., when the juice is extracted by maceration (diffusion): A. Store-room for Beetroots; B. Washer; C. Beetroot Elevator; D. Crusher; E. Maceration or Diffusion; F. Fermenting Vats; G. Savalle Stills; K. Spirit-room; L. Steam-engine; M. Steam Generators.

COST OF A BEET-ROOT SUGAR FACTORY

To Work a Crop of 500 *Acres.*

The following figures we give purposely as low as possible, but we know that a sugar factory could not be erected in England for such a small amount.

	£
Production of steam	1000
Washing and pulping	1907
Defecation	350
Scums	150
Sacks, trays, sack washing	650
Carbonation	650
Filtration	600
Evaporation of juice	2500
Crystallisation and turbing	750
Bone-black department	260
Pipes and cocks	750
Tubs and tanks	250
Carriage of machinery	500
Building	3000
	£13,317

COST OF A BEET-ROOT DISTILLERY

To Work a Crop of 500 *to* 600 *Acres.*

	£
2 Steam generators of 90 horse-power . .	880
1 Steam engine of 20 horse-power . .	300
1 Steam engine of 8 horse-power . .	104
1 Steam engine of 1 horse-power . .	72
1 Washer	48
2 Crushers	164
6 Presses	960
5 Pumps	280
2 Strainers	24
1 Mixer	28
6 Vats	143
1 Reservoir	170
Savalle Still (in iron and copper) . .	3350
Pipes and cocks	512
	*7035
Building, carriage and erection of machinery, &c.	2965
Total .	£10,000

IMPORTANT.—We took for our comparison the highest price that a beet-root distillery can cost, and the lowest that a sugar factory can cost, the above distillery could be erected for a lower price in Great Britain if with the macerator instead of the press, and where the Excise regulations do not exist, the price could be as low as £3,500.

BALANCE SHEET

Of a Beet-root Sugar Factory, to work a Crop of 500 *acres.*

The cost of such Factory being £13,317.

Dr.	£	s.	d.	Cr.	£	s.	d.
To 9600 tons of beet at 14*s.* 5*d.* . . .	6920	0	0	By 650 tons of sugar at 24*s.* per cwt.	15600	0	0
,, All the expenses	7315	0	0	,, 300 ,, molasses at 5*s.* ,,	1500	0	0
	£14235	0	0	,, 2000 ,, pulp at 20*s.* ,,	2000	0	0
Balance	4865	0	0				
	£19100	0	0		£19100	0	0

Profit . . . . £4,865 0 0 or **22 per cent.**

BALANCE SHEET

Of a Beet-root Distillery to work a Crop of 500 *to* 600 *acres.*

The cost of such Distillery being £10,000.

Dr.	£	s.	d.	Cr	£	s.	d.
To 9600 tons of beet at 14*s.* 5*d.*	6920	0	0	By 5760 tons of pulp at 8*s.*	2304	0	0
,, 672 tons of coal at 20*s.*	672	0	0	,, 192,000 gallons spirit proof at 1*s.* 10*d.* per gallon proof	17600	0	0
,, 6 tons 8 cwts. acid at 1*d.* per lb	59	14	8				
,, Labour	400	0	0				
,, Various expenses, interest, &c.	800	0	0				
,, Storage	960	0	0				
	£9811	14	8				
Balance	10092	5	4				
	£19904	0	0		£19904	0	

	£	s.	d.
Profit	£10092	5	4
Unforeseen Expenses	1092	5	4
Nett Profit	£9000	0	0 or **64 per cent.**

The plant and the working thereof are not more costly or more complicated in their manipulation than distilleries of grain, potatoes, grape-lees, &c.; the operations in beet-root distilleries do not require so much labour nor experience as grain distilleries. We therefore claim the attention of all farmers to beet-root distilleries which, at a small cost, are a valuable and productive adjunct to the establishment.

As it is of the greatest interest to compare the cost of a beet-root sugar factory and a beet-root distillery, and their balance sheets, we have given an illustration on the preceding pages, 82, 83, 84, 85.

Thus is proved that a beet-root distillery gives a profit nearly double that given by a sugar factory working the same quantity of beet.

A beet-sugar factory to work a crop of 500 acres costs (at least) . .	£13,317
A beet-root distillery to work a crop of 500 acres costs . . .	£10,000
Difference in favour of the distillery	£3,317
The profit given by a beet-sugar factory working a crop of 500 acres is .	£4,865
The profit given by a beet-root distillery working a crop of 500 acres is .	£9,000
Difference in favour of the distillery .	£4,135

VALUE

OF

BEET-ROOT GROWN IN GREAT BRITAIN.

We have frequently heard it said, that it was impossible to grow beet-root in England. To which we invariably replied that on the contrary, capital beet could undoubtedly be produced here; for why not? there is excellent beet in countries where the climate is damper and colder than that of Great Britain, where the soil is not half so good, and where farmers are greatly inferior to English agriculturists. Also, recent experiments prove that good beet can be grown in England.

In Suffolk, farmers grow first rate sugar-beet for Mr. Duncan's sugar factory; in Berkshire Mr. Robert Campbell grows first rate sugar-beet for his own distillery; and we analysed excellent beet grown in Surrey.

Dr. Voelcker made analyses of Mr. Duncan's beet-roots, and found that they contained an average quantity of sugar of 10 to 12 per cent.; our Mr. James Barral made numerous analyses of Mr. Campbell's beet-roots, and of beet-root grown in Surrey, the results being as follow :—

Beet-roots grown in Berkshire.	Water, per cent.	Sugar, per cent
1	82·64	10·74
2	81·97	11·14
3	84·47	9·52
4	84·26	9·73
5	84·29	8·52
6	86·43	7·96
7	83·73	8·85
8	83·99	10·31
9	82·09	11·71
10	85·52	8·47
11	83·26	7·95
12	87·88	6·86
13	84·47	9·52
14	84·26	9·73
15	82·09	11·71
16	87·43	9·27
17	76·99	16·46
18	81·22	13·69
19	85·84	10·34
20	86·21	8·90
21	86·56	10·13
22	86·69	8·61
23	78·55	15·01
24	79·62	12·03
25	80·09	12·17
26	85·77	9·53
27	80·98	13·84
28	82·17	13·07
29	80·68	13·19

Beetroots grown in Berkshire.	Water, per cent.	Sugar, per cent.
30	80·29	14·11
31	83·72	11·40
32	85·79	10·21
Average of 32 analyses	83·74	10·77

Beet-roots grown in Surrey.	Water, per cent.	Sugar, per cent.
1	90·85	5·83
2	86·22	9·80
3	84·83	10·90
4	84·63	8·92
5	80·66	14·62
6	88·56	7·62
Average of 6 analyses	85·95	9·61

The average quantity of water contained in the 38 above mentioned beet-roots is 84·84 per cent., and the average quantity of sugar 10·19 per cent. We could give hundreds of analyses, made by Dr. Voelcker, Dr. Church, and others, of beet-roots grown in Great Britain, the results of which are equally good. The first important point is to obtain the proper seeds, the only sorts containing a sufficient percentage of sugar are the white and red Silesian beet-roots.

This seed may be had from us by writing either to our London or Paris offices, we should be happy to procure them to oblige any one desirous of making an experiment in beet-root cultivation.

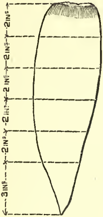
It is now practically proved that beet-roots grown in England are most suitable for distillation. It is profitable to distil sugar-beet even when they do not contain more than 5 or 6 per cent of sugar, and that because more than four-fifths of the sugar can be extracted in the state of spirit; but to manufacture sugar, the beet-root must contain at least 8 or 9 per cent., because in sugar making only one half or two-thirds of the sugar can be extracted.

The English farmers are well known to be the first in the world, (though there are in France, in the *Departement du Nord*, farmers who are as clever and intelligent as the best English farmers), and we are confident that as soon as they give their attention to beet-root growing, they will obtain better crops than those of the Continent.

To obtain good beet-root does not depend so much on the quality of the soil as on its tillage, it must be well ploughed, very deeply; it must be well manured, and that not too near the sowing season; the beet sowing season is the end of April or the beginning of May.

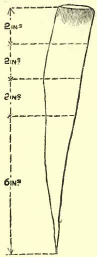
The importance of good deep ploughing is shown by these facts, that if the soil is not well tilled the beet-roots are too forky and more difficult to work in the distillery, and they are not so rich in sugar; the deep ploughing allows the beet-root to be well embedded in the soil which is most important, for the part out of the soil is not so rich in sugar, consequently in spirit as the part in the soil. Indeed, analyses of two beet-roots, one from Berkshire and one from Surrey, made by our Mr. James Barral, prove that the lowest part is the richest in sugar, richer than the middle part or the top, as shown by the woodcuts and figures following.

Beet-root from Berkshire.



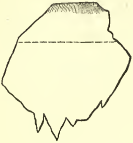
		Water, per cent.	Sugar, per cent.
Part I.	weighing 7 ozs.	88·482	5·230
Part II.	„ 11 „	88·021	7·242
Part III.	„ 12 „	86·836	8·647
Part IV.	„ 10 „	85·255	10·500
Part V.	„ 6 „	85·086	10·734
Part VI.	„ 2 „	83·595	11·062

Beet-root from Surrey.



		Water, per cent.	Sugar, per cent.
Part I.	weighing 2½ ozs.	87·39	6·02
Part II.	„ 3½ „	85·94	8·50
Part III.	„ 2 „	85·38	8·24
Part IV.	„ 1 „	83·85	9·57

Dr. Voelcker also analyzed a beet-root from Buscot and found the following result :—



		Water, per cent.	Sugar, per cent.
Top weighing	5 ozs.	89·34	4.24
Lower part weighing	2 lbs. 8 ozs.	86·05	8·05

By the above analyses it is well proved that the part out of the soil is only half as rich as the part in the soil, therefore it has been found advantageous when the beets are half grown to cover them up with the plough.

In conclusion, as proved by the most careful scientific and practical experiments, first rate beet-root can be grown in Great Britain for distilling purposes.

VALUE

OF

THE PULP AS FOOD FOR CATTLE.

We know only a few men in Great Britain who believe that the residue from beet-root distillation is a much more profitable food for cattle than raw beet. But it is easy to prove that the pulp (residue from distillation) is superior to the raw roots.

Boussingault gives the following tabular comparison of the various weights of different cattle-foods, which produce the same nutritive result :—

Wheat	55 lbs.
Rye	58 ,,
Barley	65 ,,
Clover	83 ,,
Meadow hay . . .	100 ,,
Pulp from beet-root distillation .	167 ,,
Mangold leaves . . .	230 ,,
Beet-root	669 ,,
Swedes	676 ,,

Mr. Bella, of Grignon Agricultural School, made experiments on cows with beet-root and pulp. To two cows he gave a certain quantity of hay, meal, &c., and to one some beet-root, to the other pulp instead of beet-root.

The cow kept on pulp gave more milk and of a better quality than the cow receiving raw roots. In order to avoid all errors, Mr. Bella changed the food and gave the pulp to the cow which was fed before with roots, and to the other he gave roots instead of pulp. The result was, that the one receiving the pulp, after a time, gave more milk than the other; the milk was much richer in butter, and the cow herself was in much better condition.

Besides the superiority of the pulp as food for milch cows as well as for fattening purposes, the cost is much less than that of other kinds of food.

In Morton's Cyclopædia of Agriculture we read: "one acre and a half of pasture grass is the usual allowance to each dairy cow in Gloucester, from May 1st. to December 1st. During the winter and spring months, hay is almost the only food given; and as each cow will consume two and a half tons, it requires the same extent of land—one and a half acres—for the winter or for the summer. The expense of feeding a milch cow for twelve months, is calculated at £4 for grass, one and a half acres in summer; and as the expense of hay-making and attendance falls to be added to a like quantity of land, the cost of the winter keep is not overstated at £5, which amounts to £9 per annum."

If pulp is mixed with hay, oil cake, meal, &c., the yearly cost of the food for milch cows, is reduced from £9 to £6 or £7. For fattening purposes the economy is even greater.

Thousands of farmers on the Continent have experienced the advantage of pulp feeding, and are so satisfied, that they constantly increase the growth of beet-root for distillation. For this reason, in many districts on the Continent where formerly only a few hundred bullocks were fed, after the introduction of beet-root distilleries, several thousands are fed.

Another way to compare the value of beet-root as food before distillation with that of its residue after distillation, is based on the following analyses :

	Composition of Beet-root	and	Pulp.
Water	86·05	.	85·35
SUGAR	8·05	.	0·15
*Albuminous compounds . .	0·82	.	2·05
Pectin and digestible fibre . .	0·89	.	2·17
Cellulose	3·08	.	7·80
Mineral matter	1·11	.	2·48
	100·00		100·00
* Containing Nitrogen	0·13	.	0·28

From the raw beet-root, 65 per cent of pulp is obtained; here is the comparison between 100 of beet-root and 65 per cent of pulp remaining:

	Beet-root.	Pulp.
Water	86·05	55·47
SUGAR	8·05	0·09
*Flesh-forming matters	0·82	1·34
Pectin and digestible fibre	0·89	1·41
Cellulose	3·08	5·07
Mineral matter	1·11	1·62
	100·00	65·00
* Containing Nitrogen	0·13	0·22

So that the loss is in

Water	30·58 per cent.
SUGAR	7·96 „
	38·54

And the increase consists in

Flesh-forming matters	0·52 per cent.
Pectin and digestible fibre	0·52 „
Cellulose	1.99 „
Mineral matter	0·51 „
	3·54 „

So that the total loss is 35 per cent., of which 30·58 per cent is water; the loss in sugar being 7·96 per cent.

We can express the difference between beet-root and its residue after distillation, by weight; so one ton of beet-root contains:

Water	1927 lbs. =	17 cwts.	23 lbs.
SUGAR	180 „ =	1 „	68 „
*Flesh-forming matters	19 „ =	0 „	19 „
Pectin and digestible fibre	20 „ =	0 „	20 „
Cellulose	69 „ =	0 „	69 „
Mineral matter	25 „ =	0 „	25 „
	2240 lbs. =	1 ton.	
* Containing Nitrogen	2 lbs.		

A ton of beet-roots leaving, after distillation, 65 per cent. of pulp, produces 13 cwts. of pulp, which contains:

Water	1242 lbs.	= 11 cwts.	10 lbs.
SUGAR	2 „	= 0 „	2 „
*Flesh-forming matters	30 „	= 0 „	30 „
Pectin and digestible matters	32 „	= 0 „	32 „
Cellulose	114 „	= 1 „	2 „
Mineral matter	36 „	= 0 „	36 „
	1456 lbs.	= 13 cwts.	0 „

* Containing Nitrogen . 4 lbs.

The loss by distillation consequently consists of

Water	685 lbs.	= 6 cwts.	13 lbs.
SUGAR	178 „	= 1 „	66 „
	863 lbs.	= 7 cwts.	79 lbs.

And the increase in the pulp

Flesh-forming matters	11 lbs.
Pectin and digestible matters	12 „
Cellulose	45 „
Mineral matter	11 „
	79 lbs.

The following table shows the loss and increase in the pulp:

	Beet-root.		Pulp.
Water	1927 lbs.	− 685 lbs.	= 1242 lbs.
SUGAR	180 „	− 178 „	= 2 „
Flesh-forming matters	19 „	+ 11 „	= 30 „
Pectin and soluble fibre	20 „	+ 12 „	= 32 „
Cellulose	69 „	+ 45 „	= 114 „
Mineral matter	25 „	+ 11 „	= 36 „
	2240 lbs.	− 784 lbs.	= 1456 lbs.

Loss.		Increase.	
Water	685 lbs.	Flesh-forming matters	11 lbs.
SUGAR	178 „	Pectin and soluble fibre	12 „
		Cellulose	45 „
	863 lbs.	Mineral matter	11 „
			79 lbs.

Total loss, 784 lbs., viz., 7 cwts. on 1 ton of beet-root, or 35 per cent.

Thus in giving 13 cwts. of pulp as food for cattle instead of 1 ton of beet-root, we give them: 6 cwts. 13 lbs. less of water, and 1 cwt. 66lbs. less of sugar; but we think that the loss of sugar is well compensated by the loss of water, and the increase in 11 lbs. of nitrogeneous matters, 95 lbs. of pectin and digestible fibre, 45 lbs. of cellulose, and 11 lbs. of mineral matters, especially when we consider that we can give back the equivalent of the lost sugar in straw oil-cake or meal at a very low price compared with that at which the sugar or spirit extracted from the pulp can be sold.

The spirit extracted from 1 cwt. 66 lbs. of sugar is 16 gallons proof that can be sold at 1*s.* 10*d.* per gallon, or £1 9*s.* 4*d.* for 16 gallons; which can be replaced by meal or oil-cake at a cost not exceeding 9*s.* 4*d.*, so that the nett profit in extracting the spirit from beet-root and replacing its feeding properties by straw, oil-cake, meal, &c., is at least of £1 per ton of beet-root distilled; the value of the residue or pulp, paying the expense of the distillery. The preceding calculation is in accordance with the balance sheets given on pages 61, 63, 65, where we find,

No. 1. Distillery for 2400 tons of beet-roots.

Profit	£2,408
Unforeseen expenses . .	408
Nett profit . .	£2,000

Supposing the profit to be £1 for each ton of beetroot when converted into spirit and pulp, we have

2400 tons giving £1 profit per ton	£2,400
Deducting for unforeseen expenses .	400
Nett profit . . .	£2,000

No. 2. Distillery for 4800 tons of beet-roots.

	£	s.	d.
Profit	4894	5	4
Unforeseen expenses . .	894	5	4
Nett profit . .	£4000	0	0

Supposing the profit to be £1 for each ton of beetroot converted into spirit and pulp, we have

4800 tons giving £1 profit per ton .	£4800
Deducting for unforeseen expenses .	800
Nett profit	£4000

No. 3. Distillery for 9600 tons of beet-roots.

Profit	£10,088	10	8
Unforeseen expenses . .	1,088	10	8
Nett profit . .	£9,000	0	0

Supposing the profit to be £1 for each ton of roots converted into spirit and pulp, we have

9600 tons giving £1 profit per ton .	£9600
Deducting for unforeseen expenses .	600
Nett profit	£9000

The actual balance sheets taken from the account books of beet-root distillers, and the results obtained in careful feeding experiments, afford the most convincing proofs of the highly profitable character of beet-root distillation.

WHAT IS BEET-ROOT SPIRIT GOOD FOR?

Many persons will probably say, we are convinced that beet-root distillation is a very profitable undertaking, and we know that the pulp is a useful food for cattle. But how shall we get rid of the spirit produced on our estate? What is spirit good for? Is its consumption so large that a greater number of beet-root distilleries can be erected in Great Britain without being prejudicial to one another?

Nothing is easier than to sell the spirit—there are plenty of spirit brokers who will be very pleased to sell spirit coming from British distillers, instead of German spirit which is sold in enormous quantity here.

To show that hundreds of agricultural distilleries may be erected with profit here, we have only to consider that in France there are now more than four hundred of them, and every day new ones are being erected; so it is in Prussia.

As to the uses of spirit, it is nearly impossible to detail them. Still we shall, in the following pages, give some of its applications. Spirit obtained from beet-root is applied to arts, sciences and industry in various manners which differ generally, according to the strength or state of purity of this product.

Properties of alcohol.—The alcohol obtained by the processes of distillation and rectification is never entirely pure, we mean free of water. The richest that we can thus prepare contains still 4 parts of water, or 96 volumes of alcohol in 100 ; it marks 96° by the centisimal alcohometer, or 68 over-proof by that of Sykes, and even the purest of those commonly sold in commerce, marks only 94°, or 94 per cent (65 over proof, Sykes.) If we would obtain alcohol absolutely pure or free from water we must leave it for a long time in contact with a substance having a great affinity for water, then distill and recommence two or three times these rectifications. A flask is filled with fragments of lime, upon which is poured alcohol at 65 over-proof, so as to fill up all the interstices between the pieces of lime. They are left in contact for twenty-four hours and then distilled. The distilled alcohol contains still traces of water which we remove by adding about 10 per cent of caustic potash previously fused and cast into plates. The potash is dissolved, and retains energetically the water and re-distillation is carried on by a naked fire, or, what is better, by a bath of chloride of calcium, until two thirds or three quarters of the alcohol have passed over in the distillation. The liquid is then anhydrous alcohol; it contains only a trace of an essential oil formed under the influence of the oxydising action of the air aided by the presence of the alkalies employed. Anhydrous alcohol composed of four equivalents of carbon, six of hydrogen, and two of oxygen, (or $C^4\ H^6\ O^2$,) is a liquid more fluid than water, colourless, of a rather agreeable odour at a temperature of 32° F. or that of melting ice; its specific gravity 815, water being 1000; at a temperature of 59° its density is 802. When it is heated, its dilatation is three times greater than that of water especially between 70° and 122° Fahr. An alcohometer invented by M. Silbermaun is founded on this principle. Alcohol boils at the temperature of 173° Fahr., under an atmospheric pressure corresponding to 30 inches of mercury. The vapour produced is heavier than air in the ratio of 1,859 to 1,000. Alcohol dissolves a considerable number of salts, but there are also a great number of salts insoluble in it, hence the means of analysis at the disposition of chemists. It can dissolve, also, many organic matters; resins, essences, vegetable alkalis, and fatty acids insoluble or feebly soluble in water; that is a method of separation used in chemistry. The dissolving properties of alcohol, for certain resins, are applied in different industries described further on. Alcohol can extract and separate from water different fluid matters of animal organization ; it is thus that it precipitates albumen and hardens different tissues. Pure alcohol acts as a poison on animal life ; it is not until it has been diluted with half its volume of water that it can be taken without danger into the stomach, provided the quantity be not too great, as it can produce intoxication and even cause death. Alcohol injected into a vein produces almost sudden death by coagulating the blood. Pure alcohol attracts the humidity of the air. When it is mixed with water, the combination gives rise to disengagement of heat at the same time that there is a diminution of volume. The greater contraction takes place when to 53·7 volumes of alcohol are added 49·8 of water. The total volume instead of being equal to the two volumes or 103·5 is only 100 parts. The diminution is, in this case 3.5, and the mixture corresponds to 1 equivalent of alcohol for 6 equivalents of water. Mixtures of alcohol have a less specific gravity in proportion as the quantity of alcohol is greater. It is on this principle that are constructed areometers, by means of which we ascertain the richness of alcoholic liquids which sensibly contain only alcohol and water; these liquids are, for example, the products of divers distilled vinous matters, especially brandies, spirits or alcohols of commerce.

Crude Alcohols. The alcoholic liquid obtained directly by the distillation of fermented juice is employed directly in several localities as potable spirit or brandy. It is kept for some time before being sent to market for consumption, so as to make it lose, even in closed casks, the volatile ethereous odour which it possesses when quitting the stills, and sometimes it is mingled with common brandy; in general it is coloured with caramel or burnt sugar in small proportions, or an infusion of chichory. In many cases when distilled with juniper berries it furnishes excellent gin.

Fine Spirit. Well rectified alcohol, properly so called in trade, commonly marks 65° over-proof. It is extensively used in making brandies, when freed from the very volatile oils and essences less volatile. Brought down to 49° over-proof by dilution with water, and mixed with an equal bulk of Montpelier spirit of the same strength, we have a mixture having all the apparent characters, odour and taste of cognac, or that which has been kept in wood for a year or two. Dealers who carry on these operations find them very lucrative in a double point of view, since the rectified spirit of beet-root is sold at a low price, and that its degree of strength has been reduced from 65° over-proof to 49° over-proof by the addition of water; they can add one-tenth of water, giving the second profit equal to 10 per cent. We here remark the genuine Montpelier spirit which is favourable in these mixtures, being limited in its production, especially during the last ten years, excites great competition among buyers; its price is higher than beet-root or molasses spirit in the ratio of £7 16*s* to £6 8*s* the cask of 22 gallons.

Cognac making. Beet-root spirit produced by the Savalle Stills is of such superior quality, is so pure, that it can be employed for any purpose. There is no better proof of what we say, than the use in the trade of beet-root spirit to make superfine cognac. What is sold generally as cognac is obtained as follows: 75 per cent of pure beet-root spirit, and 25 per cent of genuine cognac brandy. The cognac so obtained is preferred by many persons, its cost is shown by the following figures:—

75 gallons of pure beet-root 7° o. p. at 1*s.* 10*d.* per gallon proof	£10	0	0
25 gallons of genuine cognac brandy 7° o. p. at 20*s.*	25	0	0
100 gallons	35	0	0
1 gallon of pure cognac costs 4*s.* 3*d.* and duty paid	0	14	11
Which is sold here in London, per gallon at . .	1	8	0
Difference . . .	0	13	1

Vinage. This is a term employed in wine-growing districts to denote the operation by which the *strength* of wines, or their proportion of alcohol is increased; this is obtained by adding 1, 2, or 3, per cent of well-rectified alcohol, or, what is better *fine* rectified spirit of beet-root, exclusively used in the South of France for strengthening wines, and preferred to Montpelier alcohol. The wines thus strengthened keep better, and are free from alteration even during a sea voyage; they are consequently better adapted for exportation, and the more so in proportion as, very generally, the population of the countries in which they are consumed, are accustomed to this more alcoholic drink.

Liqueurs. Under this name are generally classed the sweet, or aromatised alcoholic preparations containing 45 to 50 per cent of pure alcohol. Such are the liqueurs, *curacao*, *aniseed*, *marasquino*, *ratafia*, *chartreuses*, &c. They are more esteemed in proportion as the alcohols employed are finer tasted and freer from the special essences and amylic alcohol which characterise all rectified products from different sources (*fecule*, *potatoes*, *grain*, *molasses*, *beet-root*, *grape-lees*, &c.)

Preservation of fruits in brandy.—Here we also employ good tasted alcohols for the much esteemed preparations which furnish in all seasons, fruits of all kinds, well preserved by the aid of alcohol, a very powerful antiseptic, and sweetened with well refined sugar free from any foreign odour; it is true that in these fruits, exempt from alteration possessing their natural characters, aroma, colour, &c., the primitive flavour is, in a great degree, concealed by the predominating tastes of the alcohol and the sugar.

Brandies.—Under this term we designate the potable products obtained from different saccharine matters submitted to alcoholic fermentation; when the strength of these liquids varies from 20° under proof to 2° under proof, they are sent to the market for consumption, especially in the country; in this state the crude alcohols, result of single distillation, contain some bitter essences, such are the spirits obtained from grain, molasses, or beet-root. Persons accustomed to these strong drinks and whose organs of taste are blunted by their abuse, seem to appreciate the amylic alcohol they contain, which renders their alcoholic degree more elevated to the taste; they prefer these crude spirits to rectified spirits of the same strength, but *apparently* less strong, of a mild flavour.

Gin or Geneva.—Often, also, especially in northern climates, the odour, the taste, and that sort of apparent strength are obtained by distilling the crude alcohols mixed with some hundreth parts of Geneva or juniper berries; adding thus new aromatic essential oils, whose strong odour exceeds all the primitive odour of the spirits employed.

Absinthe.—This liqueur, obtained by distilling brandy in contact with flowered tops of several species of absinthe, owes its aromatic odour and tonic properties to the special essential oil of the plant. This essence, soluble in alcohol, separates and appears in rendering the liquor opalescent and whitish when we add an excess of water so as to weaken the alcohol. Brandy has been very advantageously substituted for vinegar, for mixing with water, so as to procure, for troops in campaign as well as ship's crews, a beverage, light, agreeable, and healthy, the more so when a little sugar is added.

Perfumery.—There is great advantage in perfume making to employ pure spirit of high strength. The beet-root spirit produced by the Savalle Stills is generally employed for this purpose. What is spirit in perfume? simply a solvent of the essential oil or perfume; when put on the handkerchief the spirit must evaporate quickly, leaving behind the smell of the perfume. For this reason, the spirit must be pure and free from any disagreeable smell.

Aromatic Spirits.—We make profitable use of the property, possessed by alcohol, of dissolving and carrying over with it, in distillation, the odorous essential oil in preparing perfumed liquids, either by distilling with alcohol the parts of the plants containing these essences, or by dissolving, simply, several essences of agreeable odour in alcohol of various strength; these sorts of aromatic spirits contain, ordinarily, as *Eau de Cologne*, one most in use, very complicated mixtures of different essences; exposed to the air, they rapidly disengage the alcohol, whose odour predominates at first, but leaves the mixed odour of the less volatile essences for a greater or less period. We can easily discern then the disagreeable odour of amylic alcohol if, as is often the case with common products, badly rectified alcohol has been employed. The same remark applies to all cosmetic lotions which have an alcoholic base. If the alcohol be not properly rectified, it has, moreover, a most injurious effect upon the skin.

Tinctures and pharmaceutical extracts.—In the application of alcohol in pharmacy, to extract from different plants their active principle soluble in it, insoluble or little soluble in water, well rectified alcohols should always be employed, in order to avoid introducing empyreumatic oils and amylic alcohol, a portion of which would remain in the extract obtained and could alter the therapeutic agent.

Anhydrous Alcohol.—We have already indicated the preparation of this alcohol, perfectly pure, it should be strictly used in all preparatory essays and immediate essays in laboratories. (See page 102.)

Hydrotimetry.—This term is given to a process by which we determine approximately the proportion of earthy salts held in solution in spring or river water. MM. Boutron and Boudet make use of the difficulty with which *hard* water dissolves soap and makes a lather, while *soft* water dissolves it immediately and easily raises a lather; and they have composed a peculiar normal liquor and a hydrotimetric scale which shows the relative quantity of earthy salts, corresponding to a certain quantity of liquor used to produce lather. This liquor is a solution of a certain quantity of soap in diluted alcohol which must be as highly rectified as possible, as the presence of amylic alcohol would render the experiments inaccurate. In some of the applications described below, either well rectified alcohol or impure alcohols can be used; the latter from their low price are generally preferred.

Preservation of anatomical objects.—Immersion in alcohol is one of the methods in use for preserving different anatomical preparations which constitute the museums of medicine, pathology and surgery; impure alcohol charged with essence and amylic alcohol have a most remarkable antiseptic property which renders them preferable for this usage, when the preparations contain a large quantity of aqueous liquid; we must, especially if the volume of alcohol is inconsiderable, renew it once or twice to avoid all putrefaction; we can better ensure the preservation by dissolving 2 per cent. of its weight, of bichloride of mercury (corrosive sublimate.)

Preservation of Plants.—Again we dissolve, in alcohol 46° to 58° over-proof, two per cent of its weight of bichloride of mercury, to prepare the liquid for this use. After having steeped the plants for some hours in this solution they must be taken out of it, and hung up to dry in the air; the alcohol, in evaporating, facilitates the desiccation and the bichloride which remains, combined with the albuminoid matters, renders them at once imputrescible and poisonous, so that insects are kept away.

Essay of Raw Sugar.—In most sugar factories and depôts we determine the quantity of raw crystallisable sugar by submitting them to a washing of alcohol acidulated with five per cent. of acetic acid, and previously saturated with pure sugar. This liquid carries off in solution uncrystallisable sugar and some other foreign bodies, leaving the pure sugar in crystals, which are weighed and of which the proportion is thus determined in the raw sugar essayed.

Essay of Sodas.—Alcohol at 49° over-proof serves for essaying salts of soda called the *demi-caustic of commerce;* in fact it readily dissolves the caustic portion, leaving insoluble the carbonate of soda: this is then dissolved in water, so that the two solutions can easily be saturated separately by a normal acid;

the alcoholic gives the caustic alkalimetric degrees; the aqueous solution, the carbonated degrees; and the sum of the degrees indicate the total sodaic value.

Extraction of quinine, cinchonine, morphine, &c.—These immediate products of great importance in medicine, are extracted by the aid of alcohol which dissolves them, and separates them from other substances insoluble in this liquid.

Alcohol in Thermometers.—The property of alcohol resisting the lowest atmospheric temperatures and its low price compared with that of mercury, permit it to be employed in the construction of common thermometers. As alcohol boils at 173° Fahr. it is clear that they cannot give temperatures near that point; they should never be placed in boiling water. For temperatures above 167° the mercurial thermometer is necessary; it is also preferred in laboratories from the greater precision of its indications.

Spirit of wine varnishes.—The manufacture of these varnishes constitutes one of these applications which consume most alcohol; we obtain, thus, varnishes which dry quickly and exhale no deleterious vapours as do essence of turpentine varnishes: hence the preference given to spirit of wine varnishes when they are used in inhabited dwellings, or when the entire desiccation of the varnish cannot be waited for, before occupying the apartments.

Polishing of Stearine candles.—The property which alcohol possesses of dissolving fatty acids (stearic, margaric and oleic), is usefully applied to the glazing of stearine candles. In fact, it suffices to rub the candles with a cloth impregnated with alcohol to dissolve the superficial parts, to efface the roughness and by continuing for an instant a dry rubbing to polish completely all the surface.

Vulcanised india-rubber.—By adding five or six of alcohol to 100 of sulphuret of carbon, we obtain a mixture very convenient for increasing the india-rubber one half or two-thirds of its weight. The india-rubber, cut up into thin shreds, is rolled between cylinders so as to form sheets of great length, which can be moulded to any form, and receive impressions imitating different stuffs or tissues with patterns or designs in relief.

Collodion.—A mixture of eight parts of alcohol at 58° over-proof with 100 of ether, furnishes one of the best solvents of pyroxylene or gun-cotton, prepared by means of a mixture of two of sulphuric acid and one of nitrate of soda. The viscid solution of pyroxylene (after being completely washed and dried) in alcoholised ether furnishes collodion, an agglutinative substance giving an impermeable membranous sort of varnish, insoluble in water, which medical art has, during the last few years, put to such practical utility in the treatment of wounds and certain surgical operations. In photography, the consumption of alcohols, ethers and collodion, is enormous, and is daily increasing. For these delicate operations the alcohols well-rectified, or fine spirit, should alone be used.

Ether or Hydric Ether.—This product, so liquid, light, volatile, expansive, and inflammable, is obtained by a modification of alcohol in contact with sulphuric acid. Besides the numerous uses of ether in chemical analysis, pharmaceutical preparations, and some economical operations, it has been extensively used in the manufacture of artificial ice, refrigerators, and in steam-engines worked by a special contrivance, in most parts of the globe, thus giving a daily increasing employment for well rectified alcohols.

Fulminating Powder.—The consumption of alcohol in the preparation of fulminating mercury is one of equal importance with the preceding, and has been on the increase for many years.

Lighting.—Great quantities of nearly anhydrous or pure alcohol (70° or 71° over-proof,) holding in solution 18 to 20 per cent. of rectified essence of turpentine are now consumed. Several other hydrocarburets extracted from tar, and analagous by their composition to essence of turpentine are employed with alcohol. The consumption of alcohol for this purpose tends to increase, especially as it does not present the dangers so often spontaneously fatal in the use of essences of petroleum. This liquid gas is used in the interior of the palace of the Tuileries.

Calorific Power.—We need not dwell upon the extensive use of alcohol for heating purposes, in lamps made for the purpose in laboratories, in cooking apparatus, in the drawing-room—in fact, in every case in which a speedy and powerful heat is required. Small self-acting blow-pipe lamps, or colipiles, are used by gas-fitters for soldering pipes. From motives of economy they often use what is called wood-spirit, which contains a large proportion of essential oils. This causes a blackening of the joint to be soldered, and an imperfect union is effected, subject to leakage of gas, the principal cause of fires in public buildings, shops, theatres, &c., where much gas is used. This can be avoided by the use of rectified beet-root spirit.

Vinegar.—The manufacture of white vinegar, by means of alcohol, is carried on in Germany, and in some parts of France, on a very large scale; this is, again, one of those applications which the production of alcohol should develop. We employ common alcohols in the manufacture of vinegar, or acetic acid destined for industrial operations: acetates of lead, copper, potash, carbonate of lead, or white lead. Well-rectified alcohols, or fine spirit, should be exclusively employed, on the contrary, for the preparation of table vinegar, by the aid of the oxydation or humid combustion of the alcohol; thus is obtained a vinegar analogous to the Orleans vinegars, the type of good vinegars.

With beet-root spirit, pure as it is produced by the Savalle Stills, vinegar of first quality is produced at a very low rate, and it is very easy to manufacture. It consists, in filtering on beech-tree shavings eight gallons of pure beet-root spirit, 68 over-proof, mixed to ninety-two of water.

It is certain that the foreign markets for spirit will furnish a good and increasing consumption for beet-root spirits; and that new and extensive applications will continue to arise from the researches made by such numerous and indefatigable experimenters.

So great have been the improvements in the rectifying of beet-root spirits that the finely rectified spirits now introduced into the market are superior to any others before offered, this exceedingly great degree of purity is obtained by the use of Messrs D. Savalle and Co.'s (of Paris and London) improved rectifiers, for which they received a Gold Medal at Paris, 1867, and the highest diploma of honor at Havre, 1868.

USEFUL INFORMATION.

Under this title we put different particulars relating to beet-root distillation, difficult to class in the foregoing pages, as :—

1. Every beet-root sugar factory ought to have a distillery attached to it.

2. A scientific and easy method to determine the proportion of sugar in beet-root.

3. Preserving pits.

4. Cost of one gallon of beet-root spirit.

5. Comparison between the quantity of spirit yielded by one acre of rye, barley, potato, and beet-root.

6. Comparative table of the price of spirit of wine per gallon proof, 1st quality, for eighteen years.

7. Erection of beet-root distilleries.

PROFITABLE BEET-ROOT SUGAR MAKING.

A beet-root sugar factory, to be profitable, must be provided with beet containing 7 or 8 per cent of sugar, and only two thirds of the sugar be extracted in crystallizable sugar; the remaining or molasses being much more profitably distilled.

This fact is now only known by a few of the best sugar-makers, and they have always erected stills so as to be able to distill; to extract the last third of sugar in saleable sugar costs more than the extraction of the first two-thirds. Besides this, which is the most important, in case of a bad crop, that is to say if the beets contain only 5 per cent of sugar, it would be ruin to extract sugar from them, but a great profit to distil them. It is why many manufacturers on the Continent have on their premises a small distillery annexed to their sugar factory.

EASY DETERMINATION OF SUGAR IN BEETS.

This is due to M. Pelouze, a French analytical chemist, one of the greatest scientific men of our century, who studied beet-root distillation very particularly. Any person, not at all acquainted with chemistry, can with the Pelouze method, determine with great accuracy the quantity of sugar contained in beet-root.

Take about six beet-roots, cut them in half, and take a round of each. Weigh them accurately. Put them to dry at 112° Fahr. and weigh them from time to time till there is no more loss. The difference between the first weight and the last gives the quantity of water contained in the beet-roots. Then pulverize finely the dried beet-roots, after pulverization put the powder for some time at 112° Fahr. and then weigh a part of it. This part to be treated by boiling alcohol 60° over-proof. The boiling alcohol dissolves the sugar. Put to dry after having treated with spirit. The difference, between the weight after having been treated with boiling spirit and dried, and the previous weight, gives the quantity of sugar contained in the beetroot.

In evaporating the spirit, crystallisable sugar could be obtained and weighed.

This method we experimented and find that it gives very nearly the percentage obtained by the more scientific process employed in laboratories to determine the sugar in beet-root. Process impossible to be employed by persons not well acquainted with chemistry.

PRESERVING PITS.

The method actually in use for preserving beetroots from frost and universally applied, is to bury them completely by heaping them in large pits or *silos* which are constructed at little cost. If the pits are made on the field, they ought to be established at a point nearest to some road, so as to render the carriage less troublesome and costly, especially in rainy winters.

The heap of roots, in the fields, can be placed wholly out of the ground. Generally, an elevated spot is chosen, and a pit dug. The excavations should have at most a depth of two feet, so as to furnish simply the earth necessary for covering the heap. They should not be wider than three or four feet, so that we need not fear a too great accumulation of roots. The pits are filled with beet up to the height of about two feet. From this point the roots are regularly disposed, their heads being placed outwards and along the main sides of the pit. Care should be taken that the heap be formed of horizontal layers. Each layer is placed in retreat of the preceding, so that the exterior surfaces of the heap are presented under the form of inclined surfaces which meet at the summit. This ensures the speedy flow of the rain water, and the covering with earth is more easy. The roots are disposed in layers only at the sides, the rest of the space being filled up by roots in a random heap. The pit should run from north to south; it is covered at first with a layer of earth six inches thick; when the cold sets in the covering is increased up to a foot in thickness, and during the very hard season it is again increased to two or three feet.

◆

Comparison between the Quantity of Spirit yielded by an Acre of Rye, Barley, Potatoes and Beet-root.

RYE.—Crop, 16 Cwts. per Acre.

16 cwts. of Rye give:	£	s.	d.
95 Gallons Spirit proof at 1*s*. 10*d*. .	8	14	2
1232 Gallons Residue at 2*s*. per 100 gal.	1	5	0
	£9	19	2

BARLEY—Crop, 1 ton per Acre.

1 Ton of Barley gives:			
95 Gallons Spirit proof at 1*s*. 10*d*. .	8	14	2
1500 Gallons Residue at 2*s*. per 100 gal.	1	10	0
	£10	4	2

POTATO—Crop, 6 Tons per Acre.

6 Tons of Potatoes give:			
190 Gallons Spirit proof at 1*s*. 10*d*..	17	8	4
12 Cwts. Residue at 1*s*. . .	0	12	0
	£18	0	4

BEETROOT—Crop, 20 Tons per Acre.

20 Tons of Beet-roots give:			
360 Gallons Spirit proof at 1*s*. 10*d*. .	33	0	0
5 Tons Pulp at 8*s*. . . .	2	0	0
	£35	0	0

COMPARATIVE TABLE

OF THE

Price of Spirit of Wine per Gallon proof, 1st Quality,

ON THE PARIS EXCHANGE FOR 18 *YEARS.*

Year.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Yearly Average.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1852	1	6	1	9	1	8	1	8	1	10	1	9	2	2	2	2	2	2	2	6	2	8	2	8	**2**	**0**
1853	2	8	2	8	2	6	2	6	2	2	2	2	2	8	3	0	3	11	3	8	3	11	4	4	**3**	**0**
1854	4	2	3	8	3	4	3	1	3	1	3	6	4	2	4	4	4	0	3	11	3	9	3	8	**3**	**8**
1855	3	0	3	0	3	0	3	0	3	0	3	0	3	2	3	1	2	10	2	6	2	6	2	6	**2**	**10**
1856	2	6	2	4	2	2	2	6	2	6	2	10	3	4	3	5	3	1	3	2	3	2	3	2	**2**	**10**
1857	3	2	2	10	2	10	2	10	2	10	2	6	2	8	2	6	2	5	2	6	1	9	1	8	**2**	**6**
1858	1	7	1	6	1	7	1	3	1	3	1	4	1	3	1	3	1	2	1	2	1	5	1	7	**1**	**4**
1859	1	8	1	8	1	8	1	8	1	10	2	2	2	0	2	0	2	2	2	5	2	5	2	1	**1**	**11**
1860	2	0	2	2	2	6	2	5	2	6	2	5	2	2	2	3	2	5	2	4	2	2	2	2	**2**	**3**
1861	2	4	2	4	2	4	2	5	2	4	2	2	2	0	1	11	2	1	2	0	1	9	1	8	**2**	**1**
1862	1	9	1	9	1	9	1	9	1	8	1	8	1	9	1	9	1	11	1	10	1	8	1	6	**1**	**8**
1863	1	8	1	7	1	7	1	7	1	7	1	7	1	8	1	10	1	8	1	9	1	8	1	10	**1**	**8**
1864	1	10	1	9	1	9	1	9	1	9	1	8	1	7	1	8	1	9	1	9	1	6	1	6	**1**	**8**
1865	1	5	1	3	1	3	1	3	1	3	1	4	1	5	1	2	1	2	1	2	1	1	1	0	**1**	**2**
1866	1	0	1	1	1	2	1	3	1	3	1	3	1	5	1	2	1	5	1	5	1	5	1	6	**1**	**3**
1867	1	6	1	5	1	5	1	7	1	5	1	5	1	7	1	7	1	8	1	7	1	6	1	6	**1**	**6**
1868	1	7	1	8	1	10	2	0	2	0	1	11	1	8	1	8	1	9	1	8	1	9	1	9	**1**	**9**
1869	1	8	1	8	1	8	1	8	1	10	1	10	1	7	1	6	1	7	1	7	1	5	1	4	**1**	**7**
Monthly Average.	**2**	**0**	**2**	**0**	**2**	**0**	**2**	**0**	**2**	**0**	**2**	**0**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**0**	**2**	**0**

Average price, during Eighteen Years, of Spirit, 1*st quality, per Gallon proof,* **2s.**

COST

OF

One Gallon Proof of Superfine Spirit of Wine (from Beet-root.)

	£	s.	d
5 tons of Beet-root at 14*s.* 5*d.*	3	12	1
7 cwts of Coal at 1*s.*	0	7	0
12 lbs. of Acid at 1*d.*	0	1	0
Labour	0	6	0
Various Expenses, Interest, &c.	0	11	3
Warehousage	0	10	0
	£5	7	4
3 tons of Pulp at 8*s.*	1	4	0
Nett Cost of 100 Gallons proof Spirit	£4	3	4

One Gallon Proof of Beet-root Spirit 1st quality cost 10d.

ERECTION OF BEET-ROOT DISTILLERIES.

Messrs. D. Savalle and Co. undertake to erect and fit complete any kind of distillery; the Berkshire Distillery Company has been entirely built, erected and fitted according to their plan and with their Stills. The number of grain, molasses or beet-root distilleries erected by them in the world is *now* (November, 1870) more than **540.**

The best sugar-beet seed is to be procured in Paris, the centre of continental industry. Messrs. D. Savalle & Co, inventors of the most powerful and effective Stills both for distillation and rectification, suitable either for the farmer or professional distiller, will furnish warranted sugar-beet seed to all persons who apply to them No. 64, Avenue de l'Impératrice, Paris, or at their London office, 10, Basinghall Street, where persons interested in beet-root distillation can obtain :—

1. Letters of introduction and admission enabling the bearers to visit the principal grain, molasses or beet-root distilleries in Europe.

2. Permission to visit the different cattle farms where beet-root pulp, the residue after distillation, is made use of for fattening cattle.

3. Plans and estimates of beet-root distilleries to be set up either in new buildings or to be adapted to those already existing. Every information necessary for distilling and rectifying either beet-root, grains or molasses, are furnished by Messrs. Savalle & Co.

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